Appendix B: Time Series Comparisons 2002-2011

The eutrophication model was verified to the period 2002-2011. Verification implies the 2002-2011 observations were not considered in the parameter specification based on 1991-2000 data. Data for model calibration was obtained from the data base maintained by the EPA Chesapeake Bay Program (http://www.chesapeakebay.net/data/index.htm). Observations were obtained from 40 stations among the larger number in the monitoring program (Figure 1). We selected one station in each major Chesapeake Bay Program Segment (CBPS) as well as stations in multiple smaller segments. Time series comparisons were completed for 19 water quality components, at one to three depth intervals, at each station. Comparisons included physical quantities (salinity, temperature, suspended solids, light attenuation), chlorophyll, dissolved oxygen, and multiple forms of carbon, nitrogen, and phosphorus. We concentrate here on the components which correspond closely to chlorophyll, clarity, and dissolved oxygen.

This appendix presents four pages for each time series station. Description of the presentation for each station follows.

Chlorophyll Surface. Ten-year time series of computed and observed chlorophyll 'a'. The time axis on this and the following plots commences on January 1, 2002, and runs through January 31, 2011. In this and following plots, instantaneous observations from the surface sample (1 m) are plotted along with daily-average model values in the cell which corresponds to the monitoring station.

Light Extinction. Ten-year time series of computed and observed diffuse light attenuation. Attenuation was almost exclusively derived from irradiance observed at multiple depths in the water column.

Dissolved Inorganic Nitrogen Surface. Ten-year time series of computed and observed dissolved inorganic nitrogen. DIN is computed as the sum of ammonium and nitrate nitrogen.

Dissolved Inorganic Phosphorus Surface. Ten-year time series of computed and observed dissolved inorganic phosphorus.

Algal Limits. Ten-year time series of computed nutrient limitations on phytoplankton production in the model surface cell. Nutrient limits are daily average values. The limitations are biomass weighted according to the algal groups present. A limitation of zero indicates complete limitation to growth. A limitation of unity indicates no limitation.

Total Nitrogen Surface. Ten-year time series of computed and observed total nitrogen.

Total Phosphorus Surface. Ten-year time series of computed and observed total phosphorus.

Statistics. The mean difference (MD) and absolute mean difference (AMD) statistics are provided for the computations and observations at this station. These statistics are defined:

$$MD = \frac{\sum(P - O)}{N} \quad (1)$$

$$AMD = \frac{\sum|P - O|}{N} \quad (2)$$

in which:

MD = mean difference
AMD = absolute mean difference
O = observation
P = prediction
N = number of observations

Dissolved Oxygen. Ten-year time series of computed and observed dissolved oxygen. The presentation varies depending on local depth of the monitoring station. Comparisons are always presented for the surface sample. At deeper stations (typically prefixed RET and EE) comparisons are presented at the surface and bottom. At stations deep enough to warrant sampling near the pycnocline (typically prefixed CB and LE) comparisons are presented at the surface, mid-depth, and bottom. Statistics correspond to the number of depths plotted.

Light Extinction. Ten-year time series of computed and observed diffuse light attenuation.

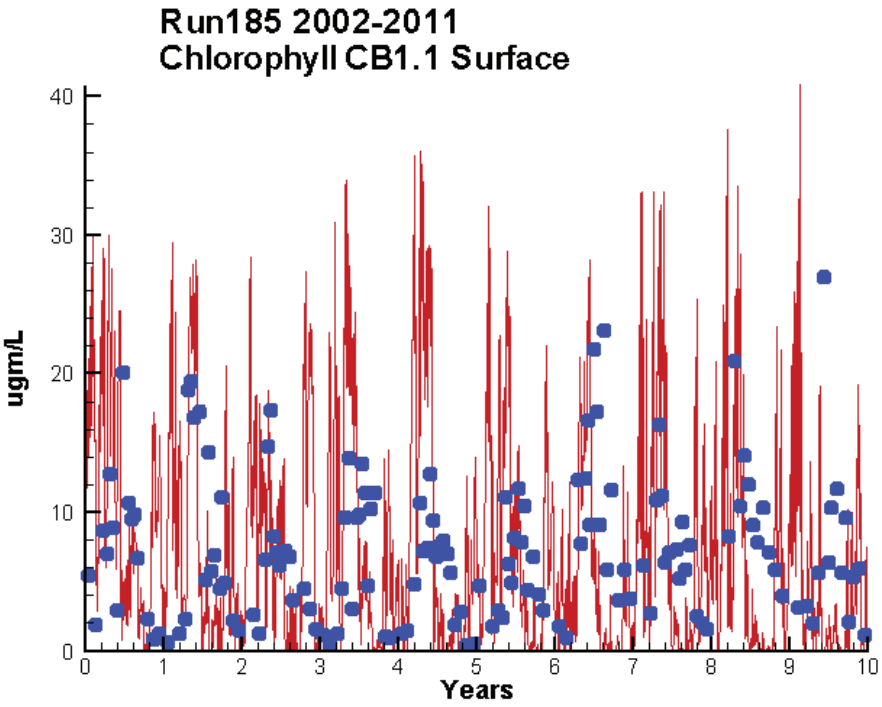
Total Solids Surface. Ten-year time series of computed and observed total suspended solids. Model TSS is the sum of the four fixed solids variables (fine clay, clay, silt, sand) plus particulate organic carbon components (algal carbon, zooplankton carbon, labile and refractory particulate organic carbon). Organic

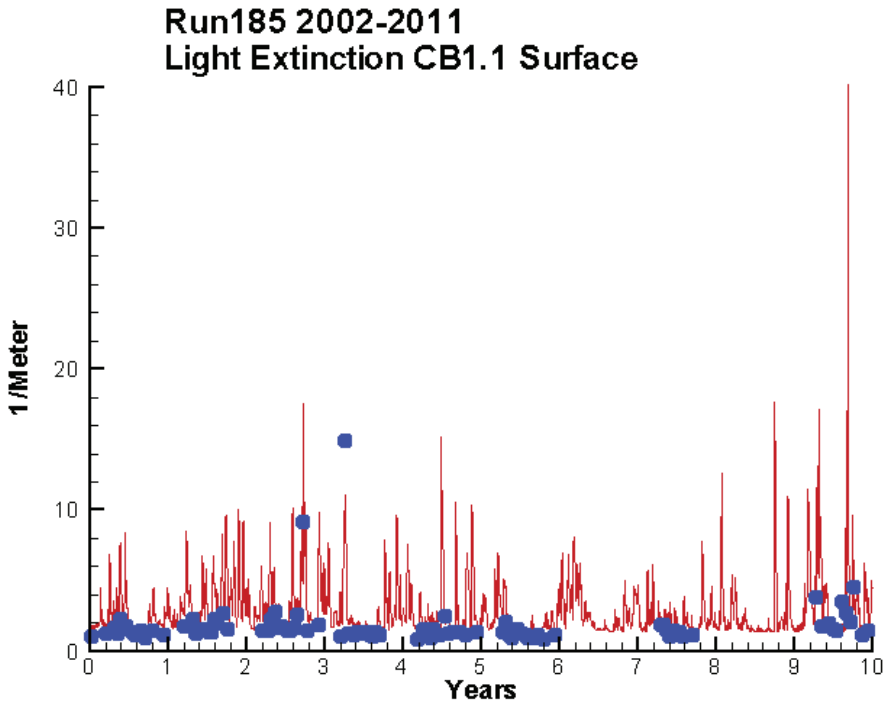
carbon is converted to solids through multiplication by the ratio 2.5 g solids g^{-1} C.

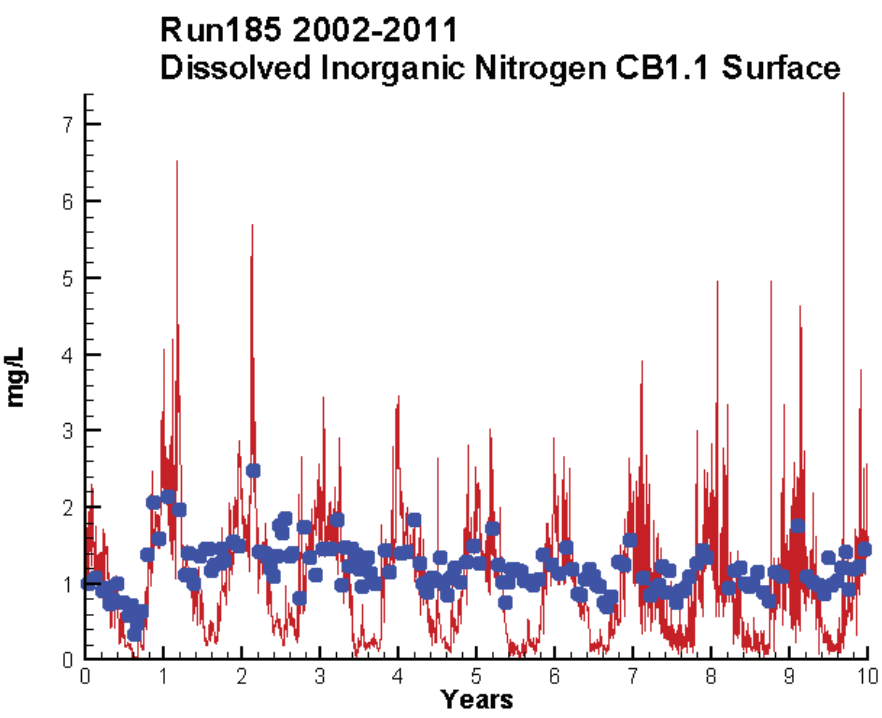
Solids Surface. This graph separates computed fixed (inorganic) and volatile (organic) solids. Volatile solids are obtained from modeled carbon as noted above. No observations are shown since these fractions are not regularly observed in the monitoring program.

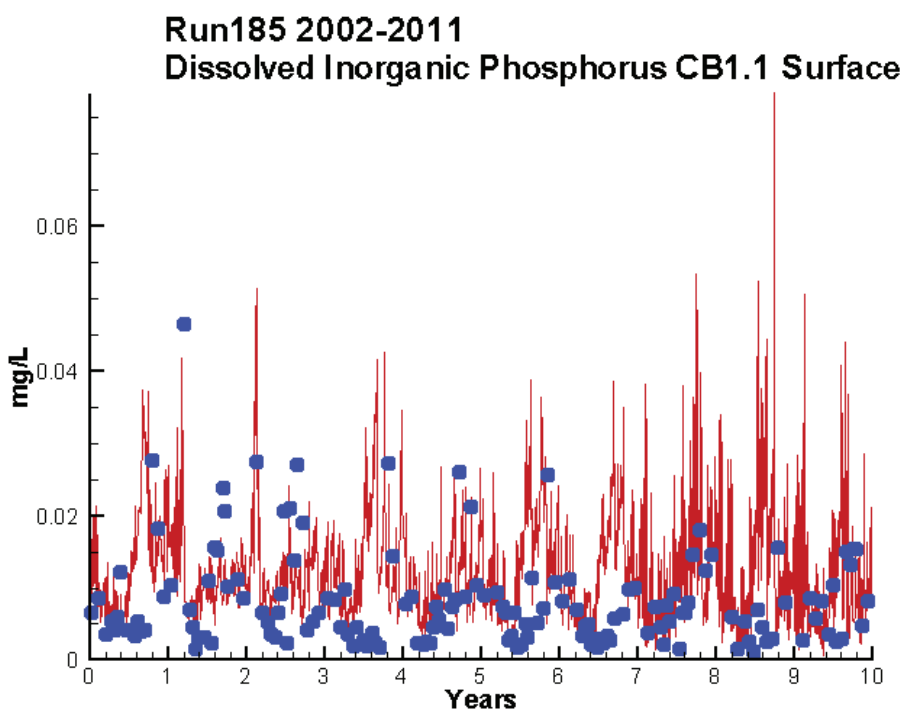
Figure 1. Monitoring stations. Forty stations were selected from this group for time series analysis.

Station CB1.1

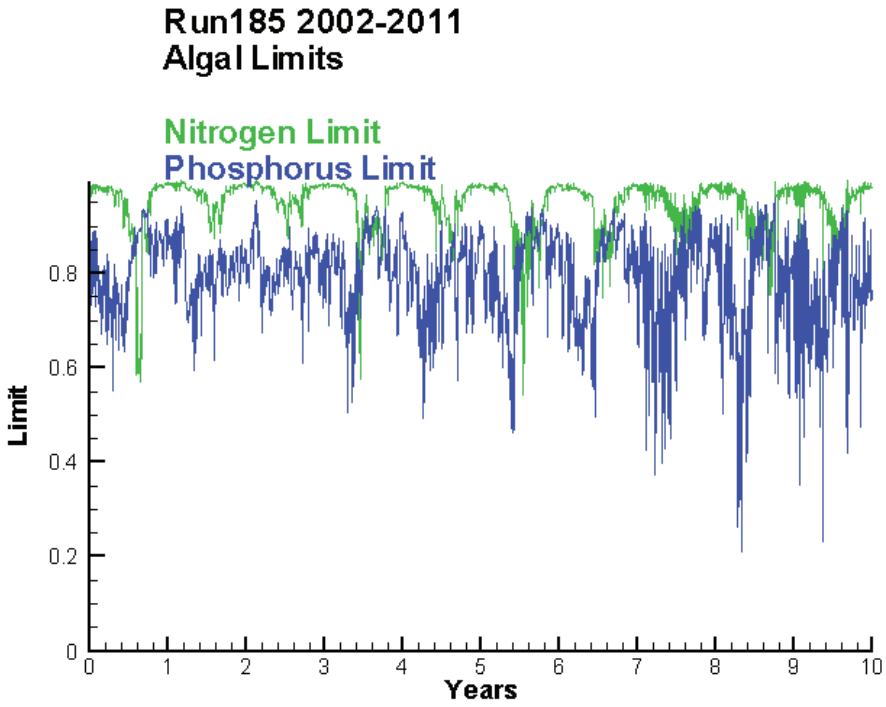


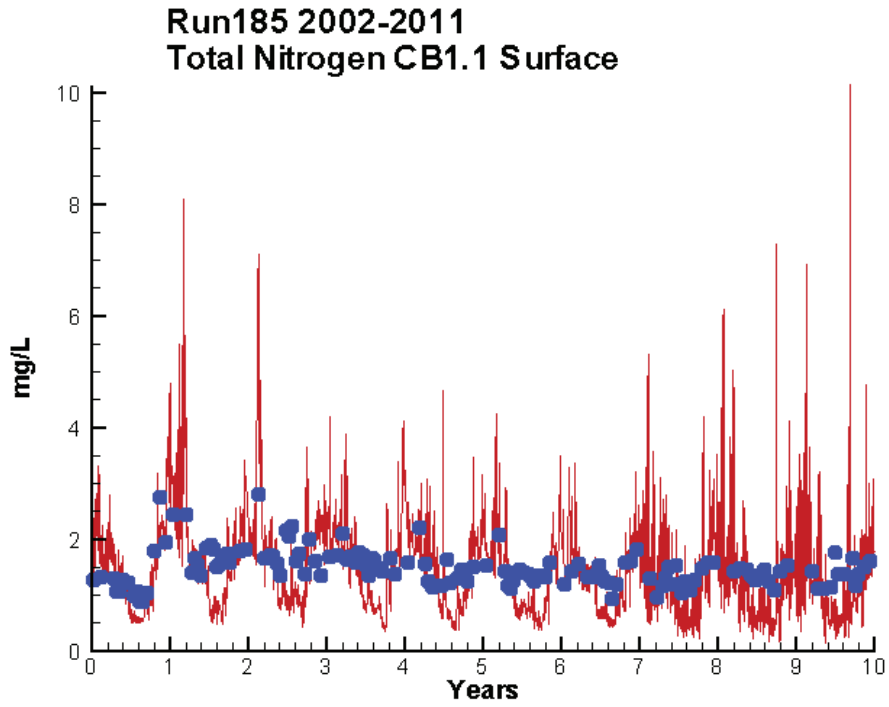


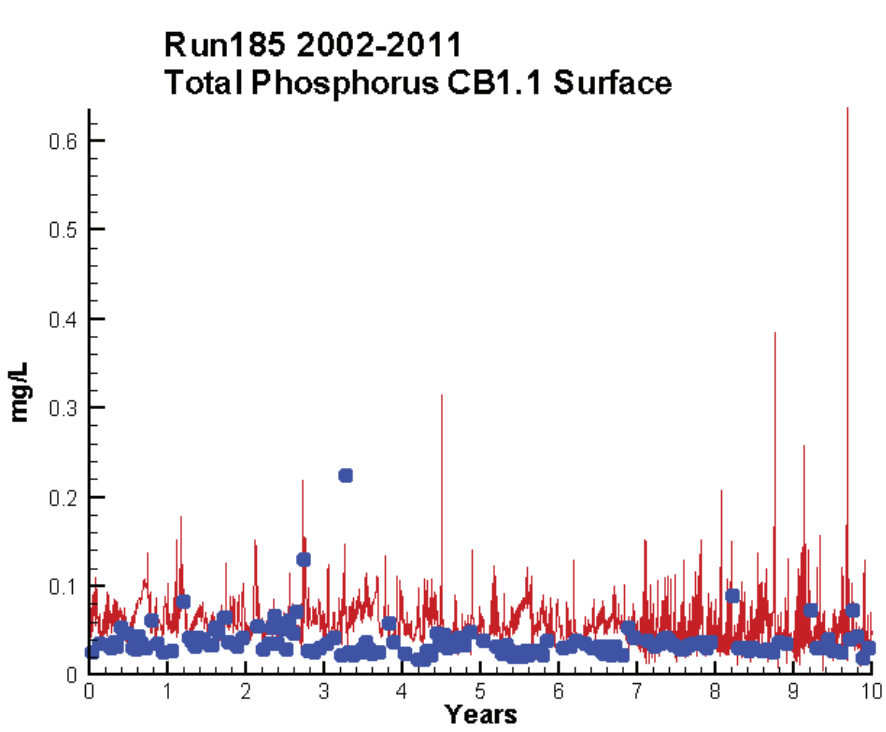




Station CB1.1

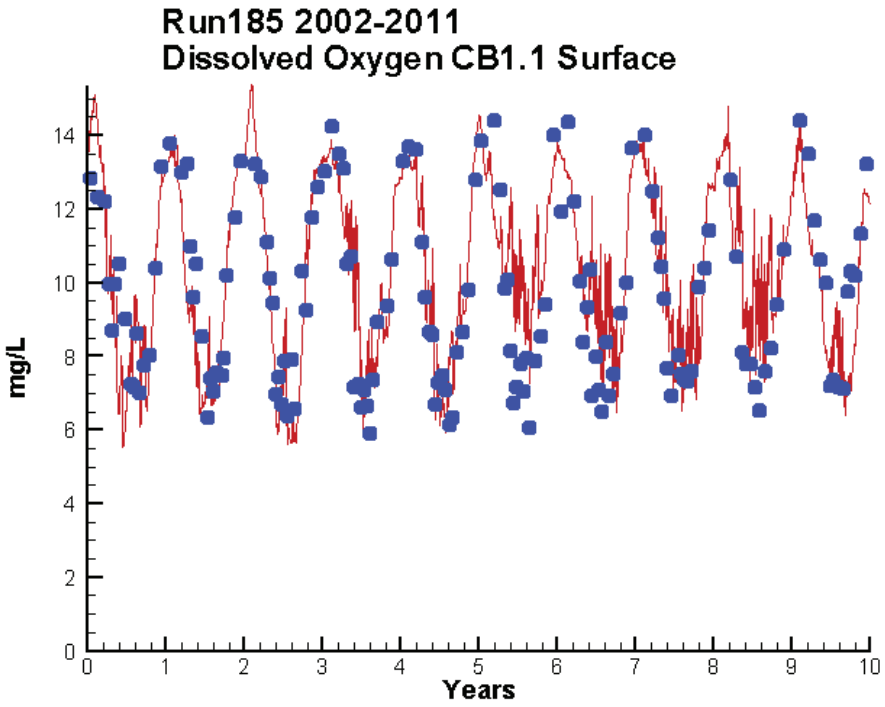




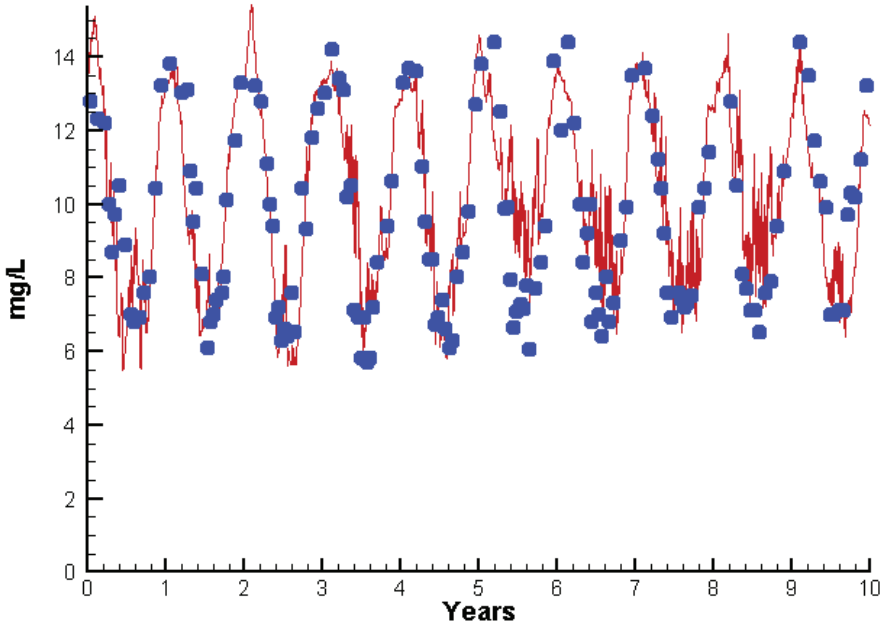


	Mean Difference	Absolute Mean Difference
Chl	0.7940	7.3501
DIN	-0.3590	0.5623
KE	0.9067	1.1046
DIP	0.0038	0.0072
TP	0.0205	0.0263
TN	-0.1669	0.5541

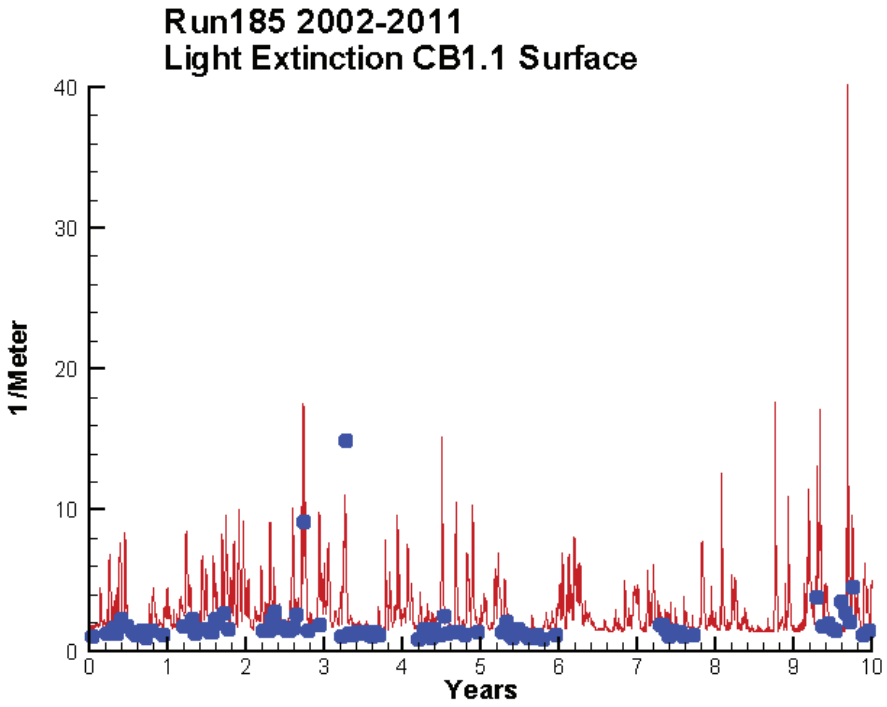
Station CB1.1

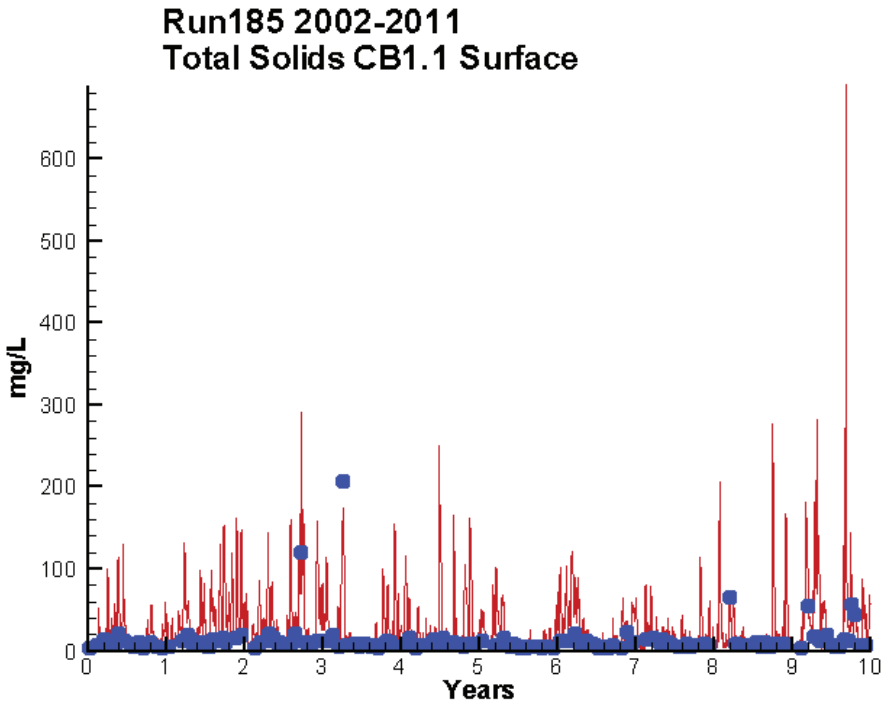


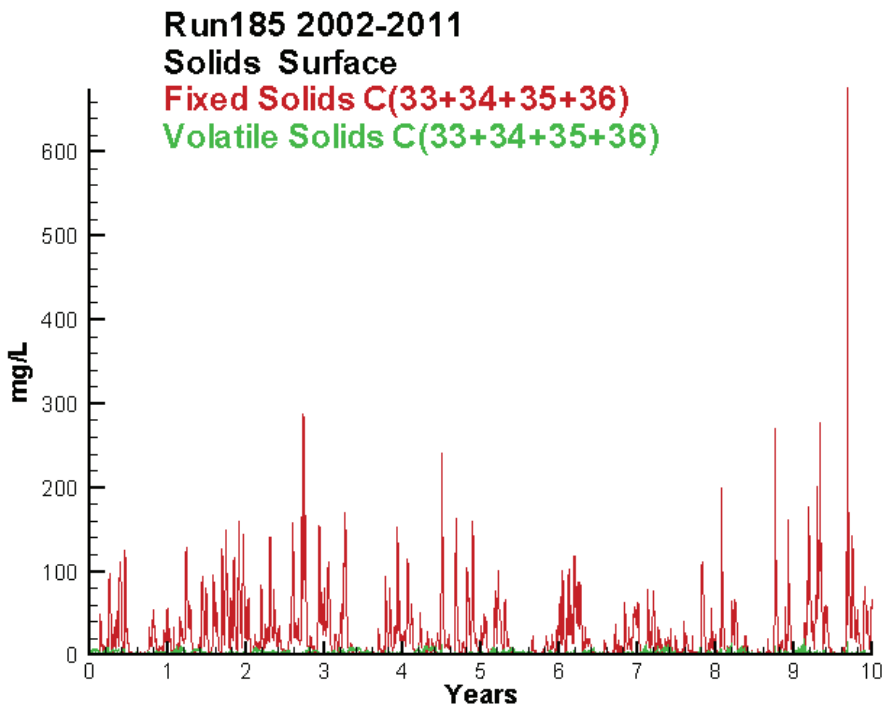
	Mean Difference	Absolute Mean Difference
Top DO	0.2177	1.0974
Bot DO	0.1943	1.0546



Station CB1.1

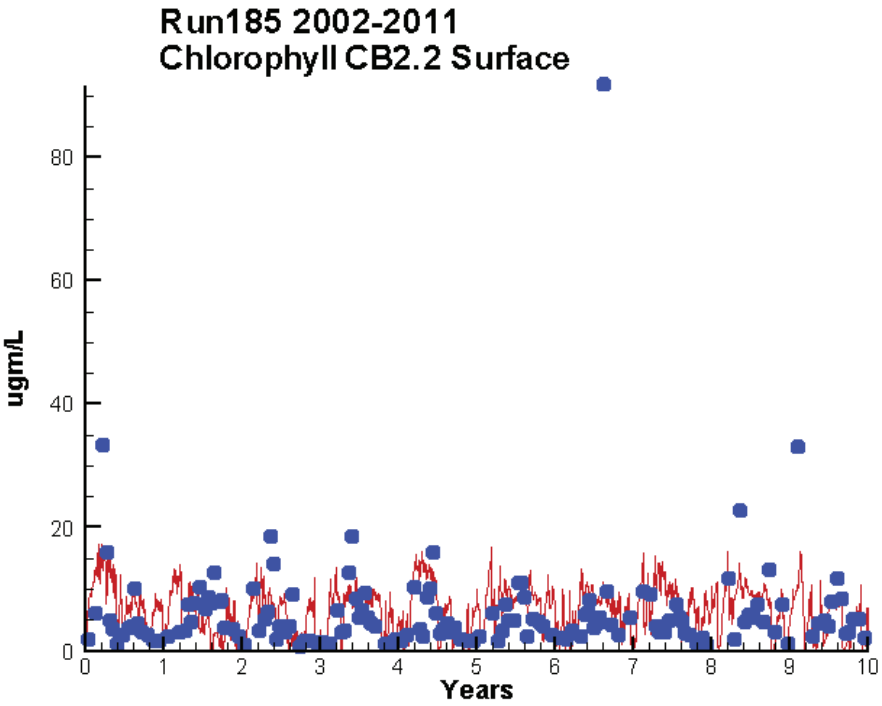


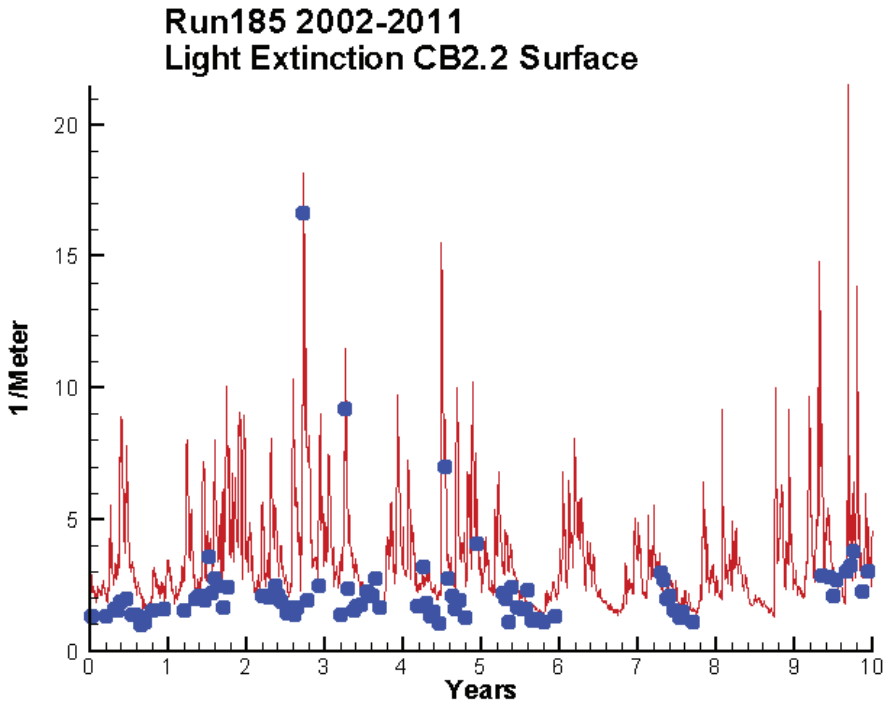


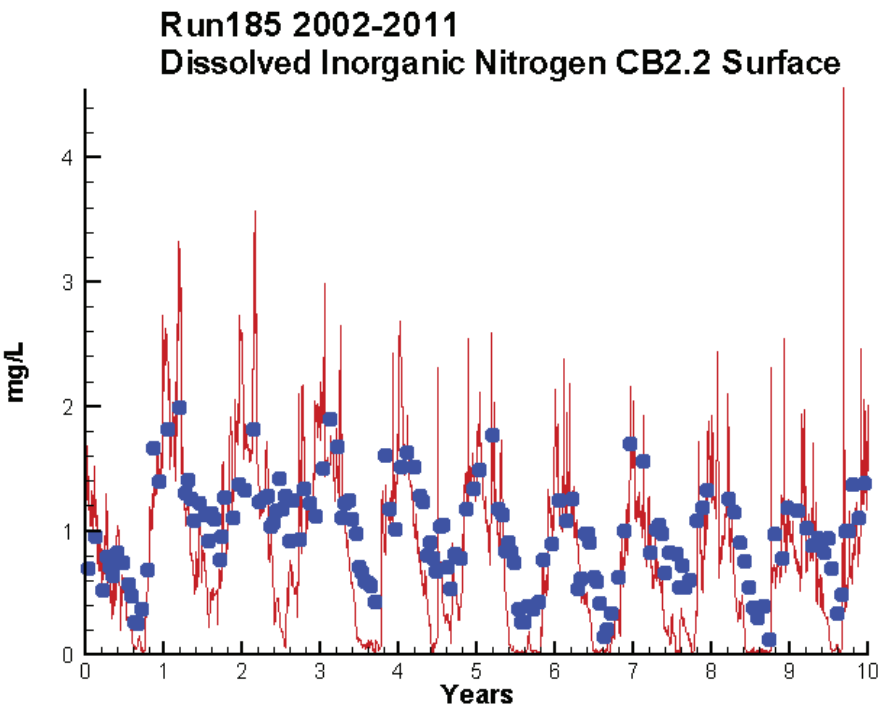


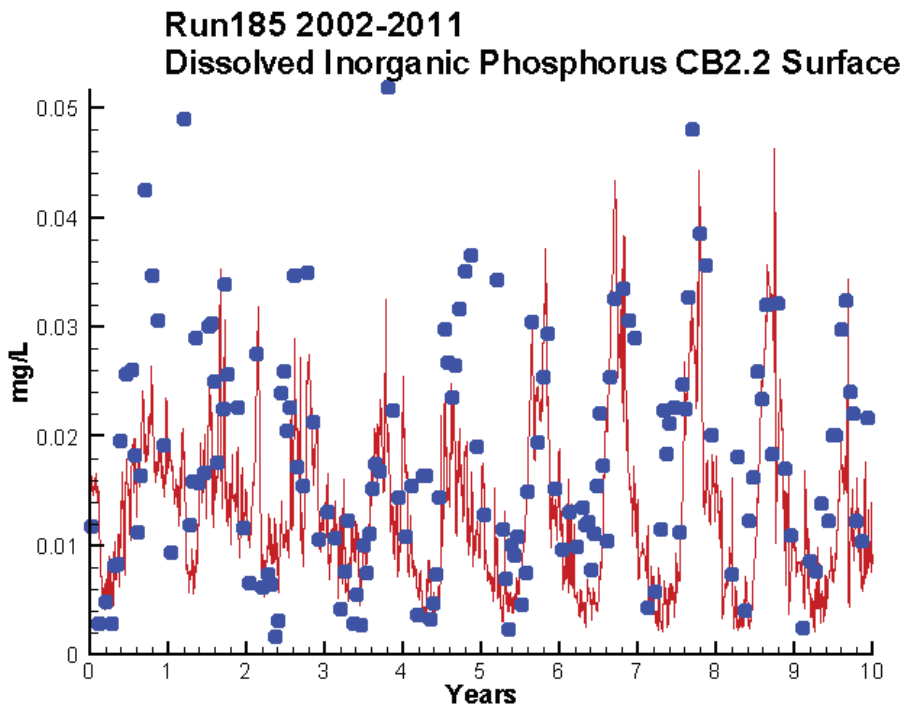
	Mean Difference	Absolute Mean Difference
KE	0.9067	1.1046
TSS	13.0704	15.4715

Station CB2.2

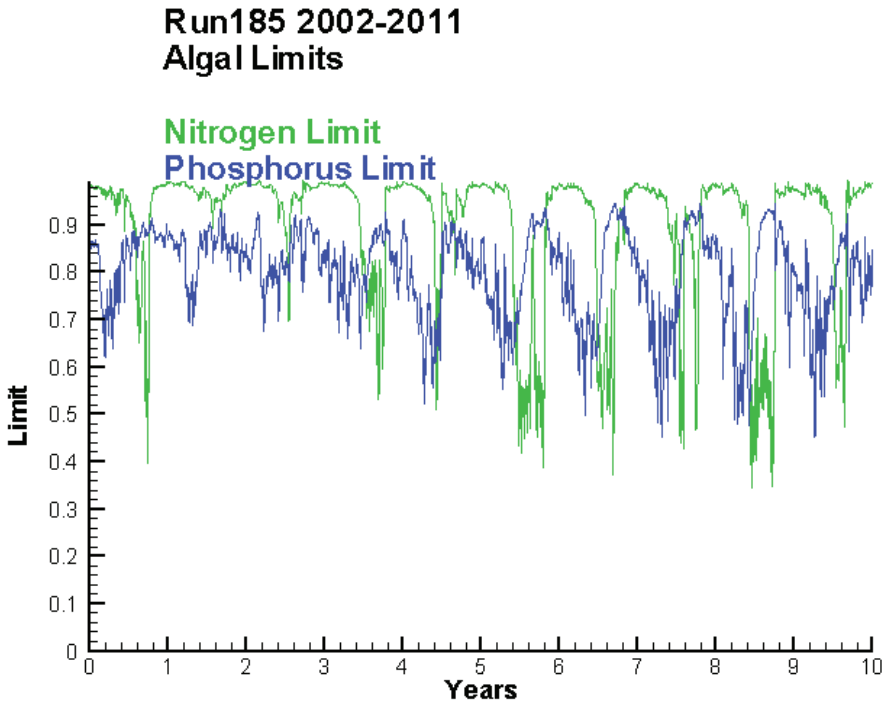


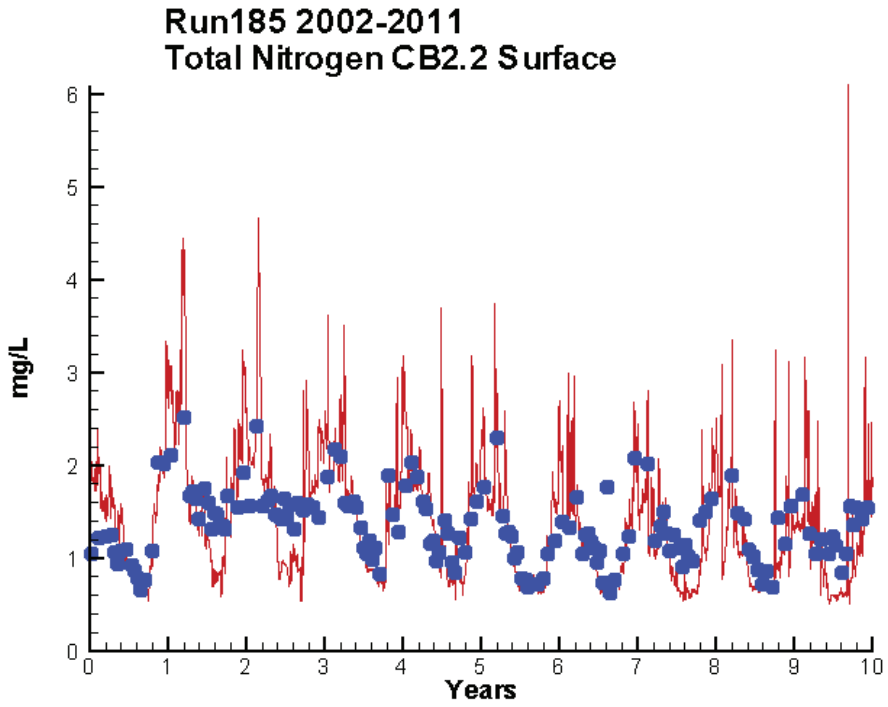


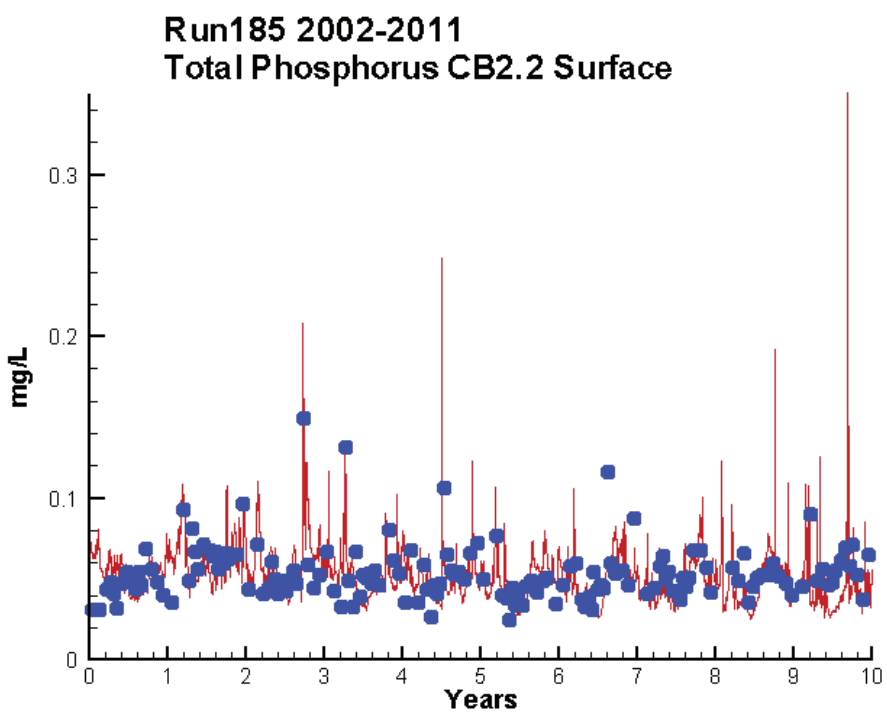




Station CB2.2

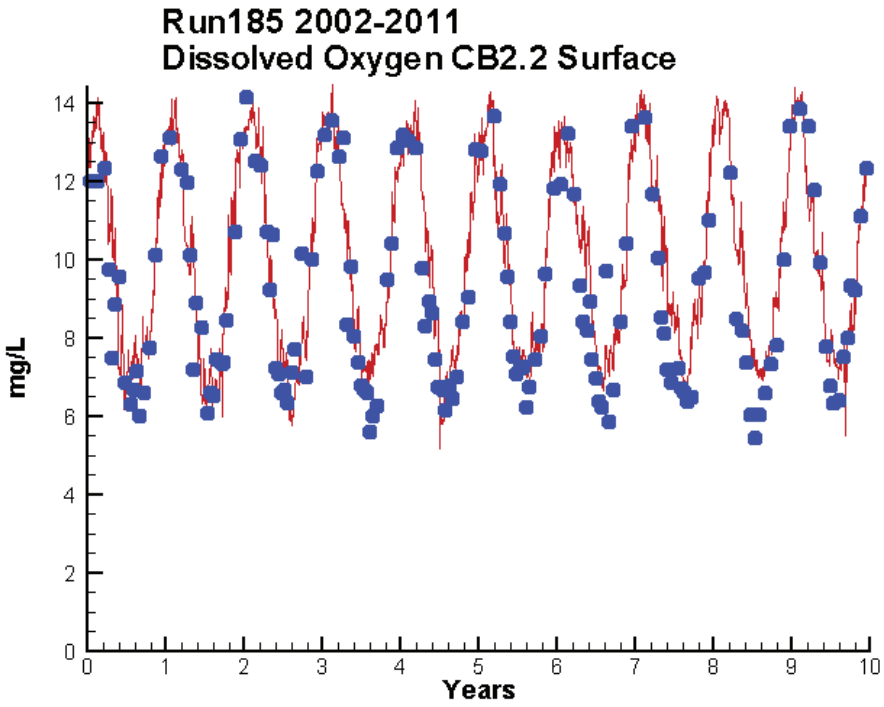


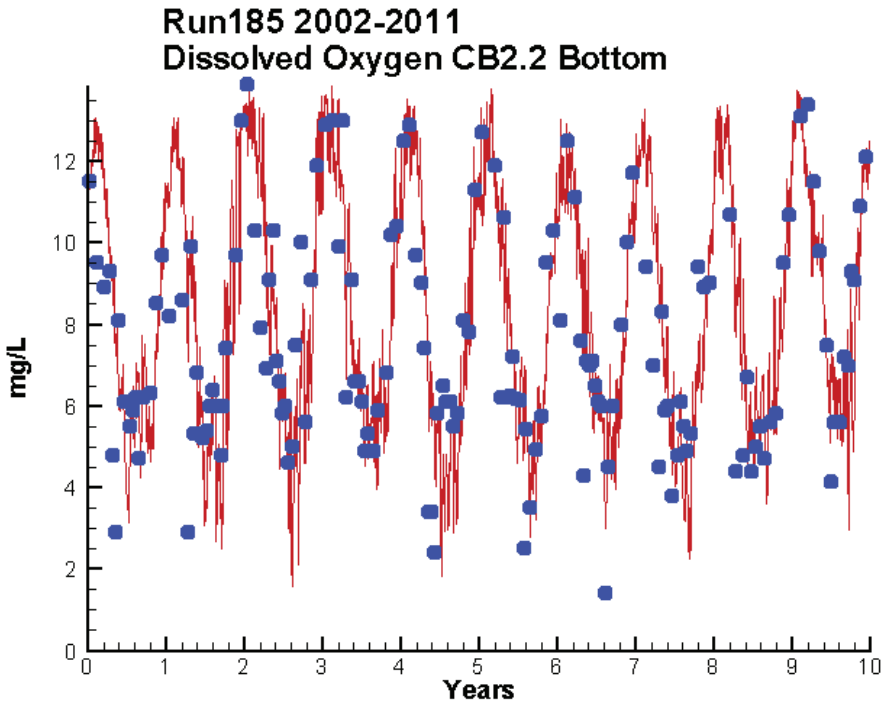


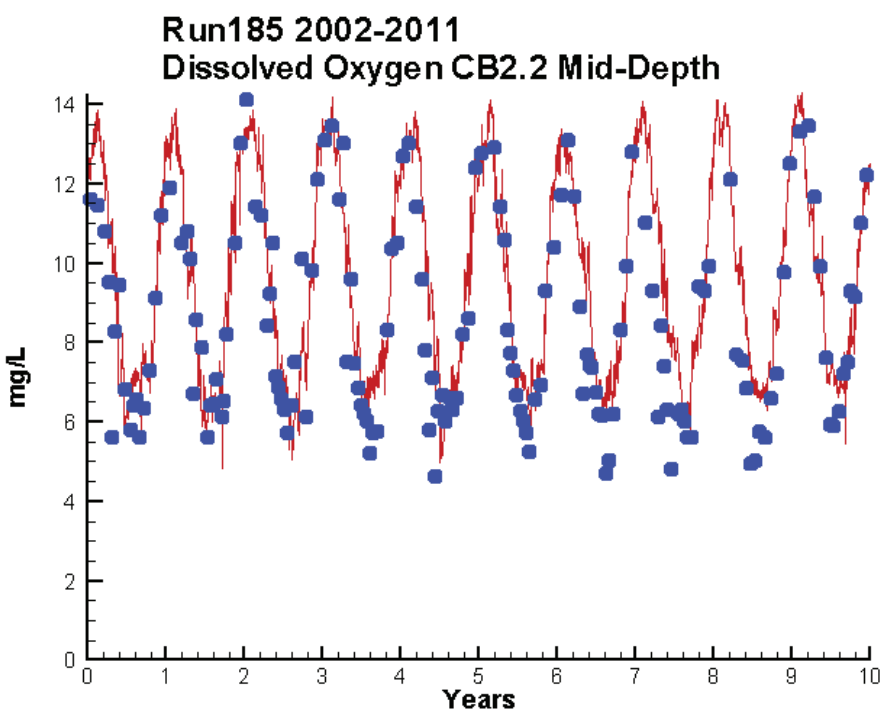


	Mean Difference	Absolute Mean Difference
Chl	0.5643	4.5063
DIN	-0.2502	0.3975
KE	1.3096	1.3702
DIP	-0.0047	0.0073
TP	-0.0028	0.0132
TN	-0.0601	0.3057

Station CB2.2

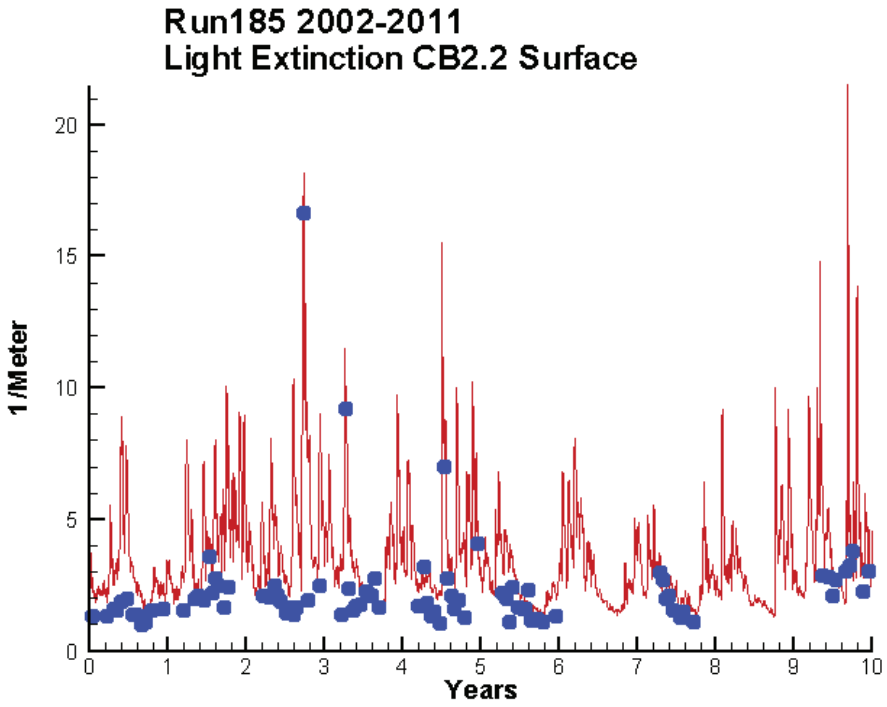


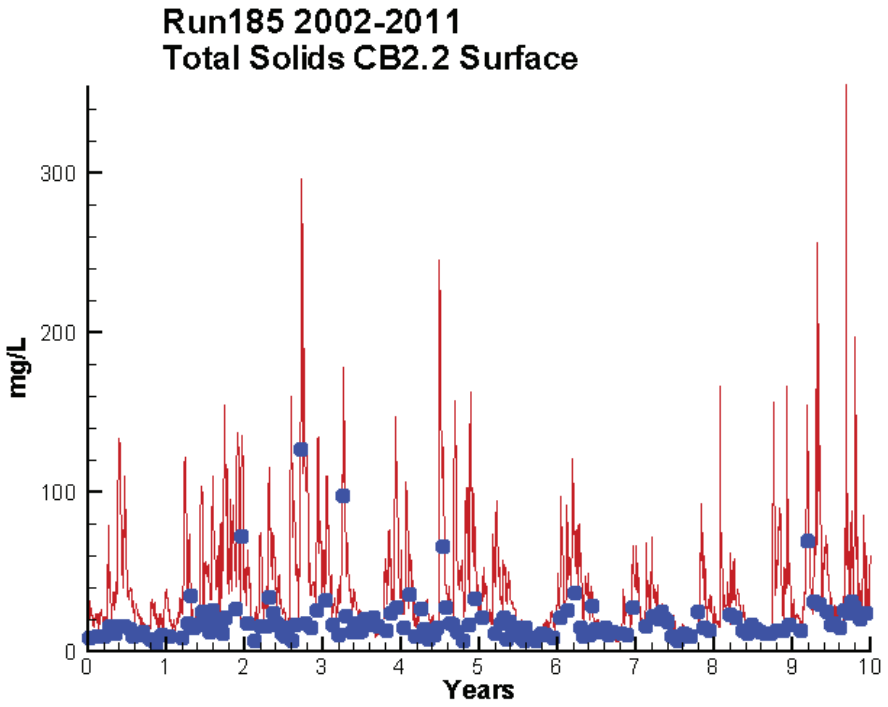


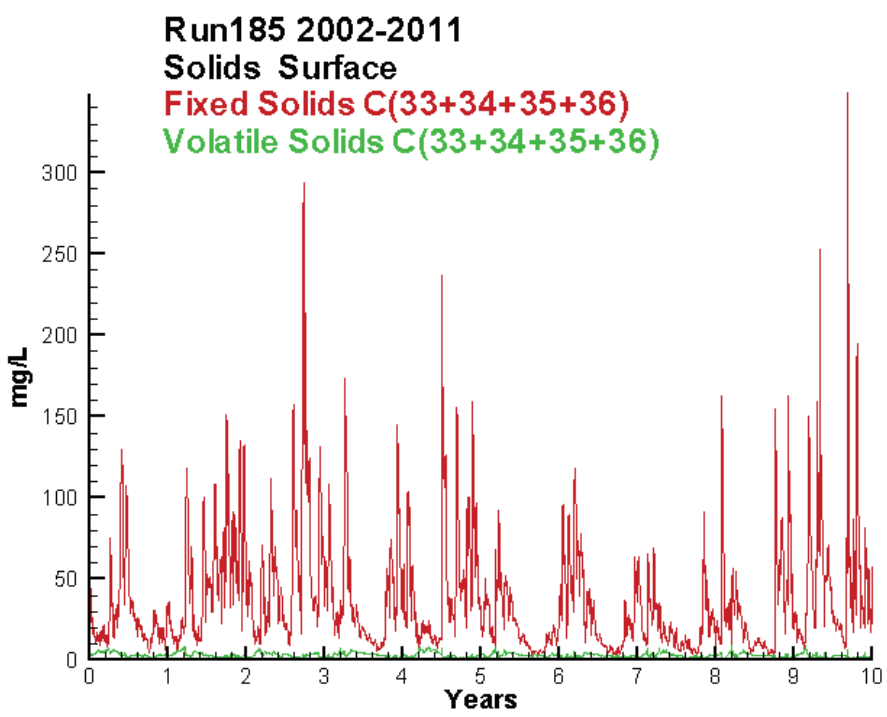


	Mean Difference	Absolute Mean Difference
Top DO	0.4306	0.8911
Mid DO	0.6398	1.0681
Bot DO	0.1574	1.3676

Station CB2.2

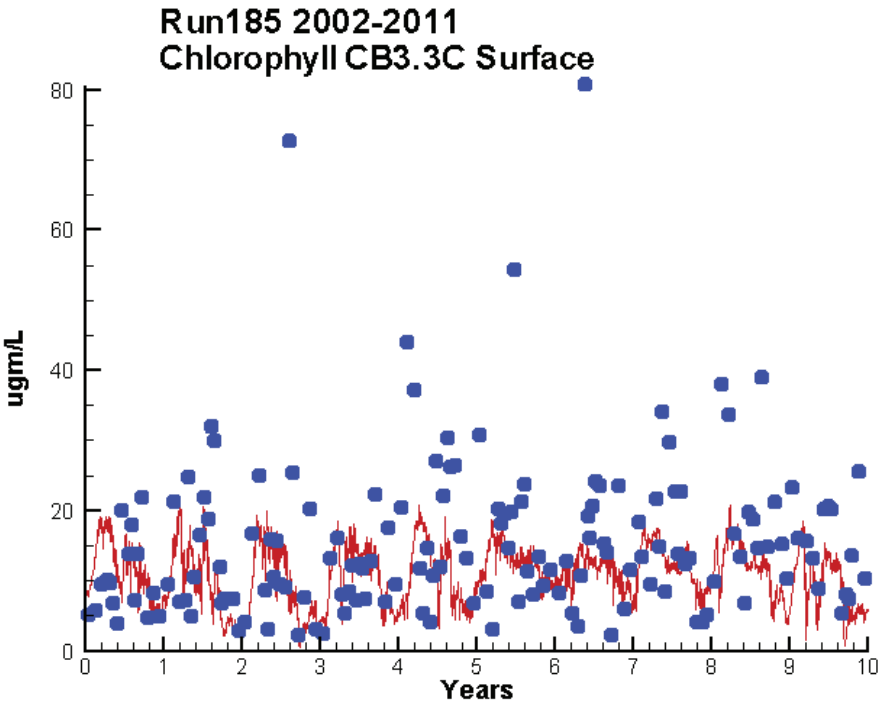


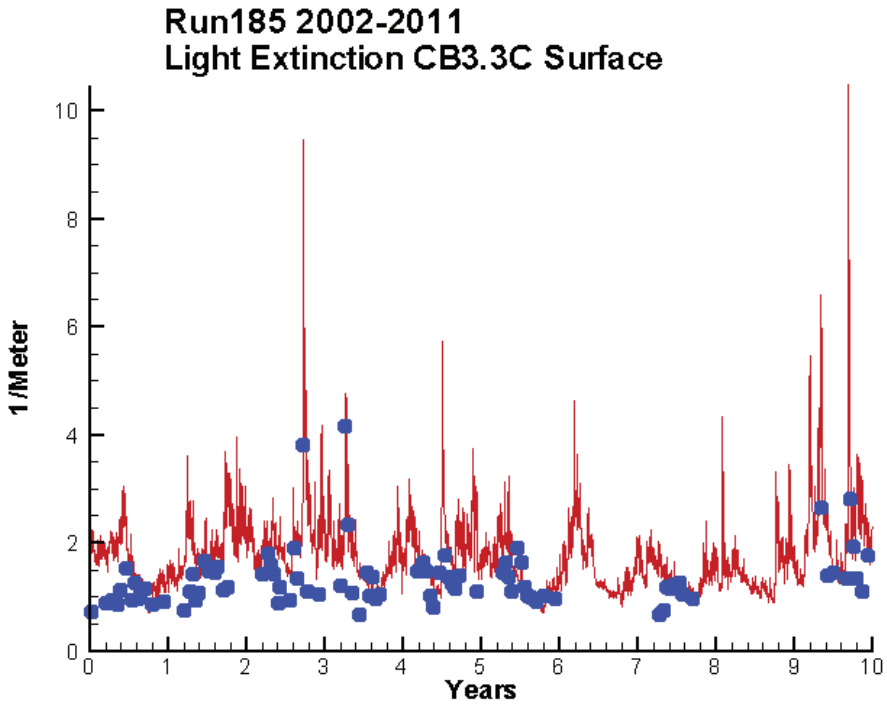


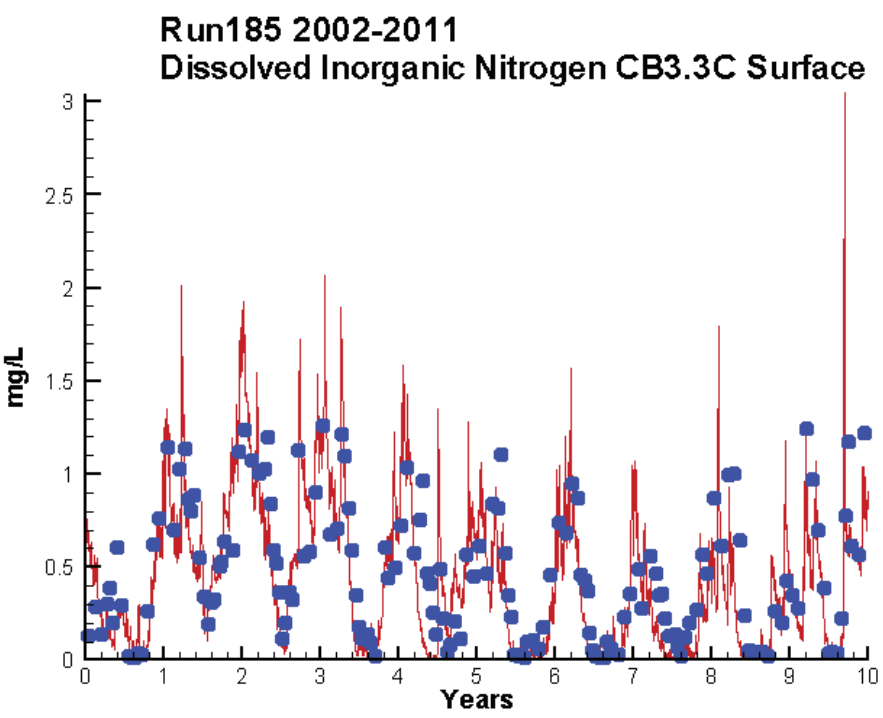


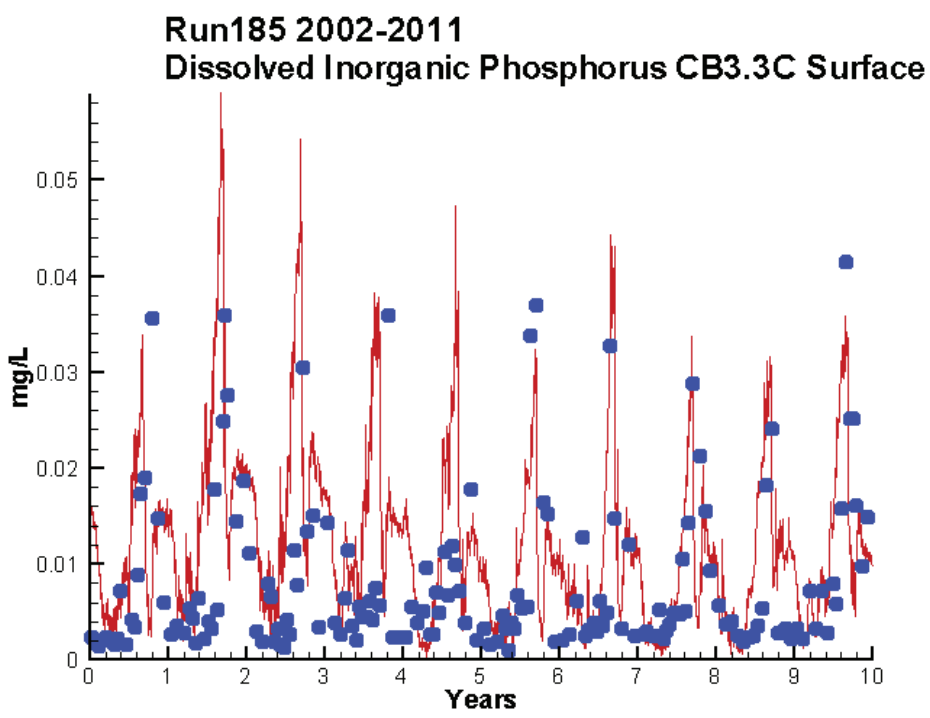
	Mean Difference	Absolute Mean Difference
KE	1.3096	1.3702
TSS	21.5525	22.2203

Station CB3.3C

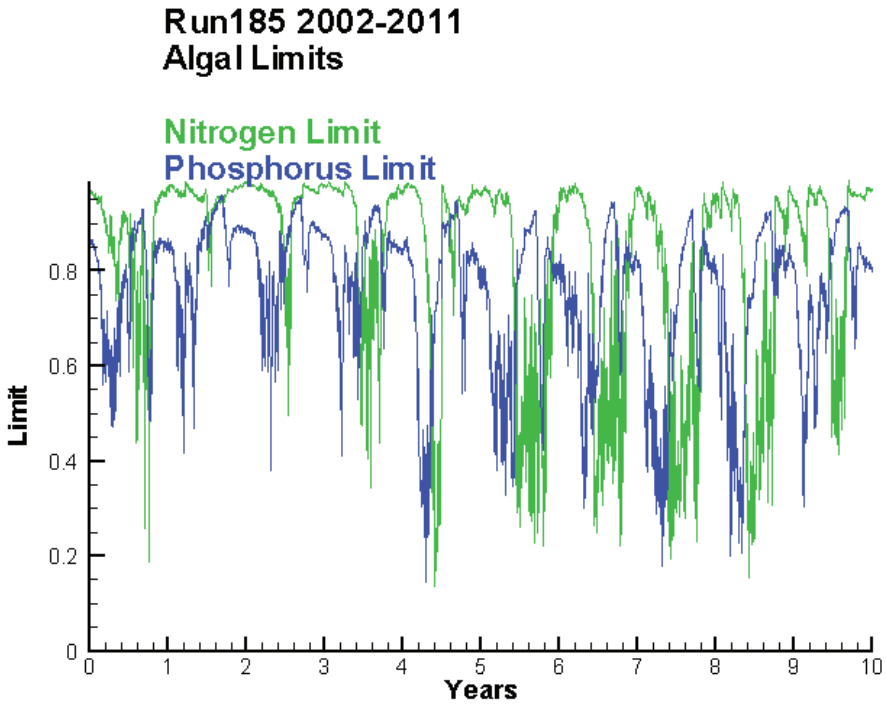


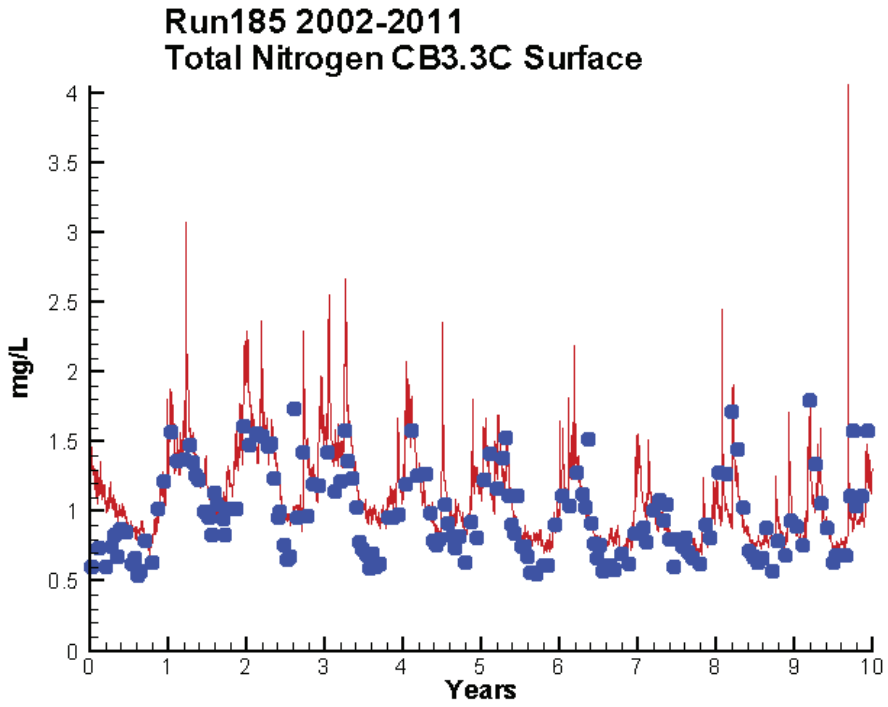


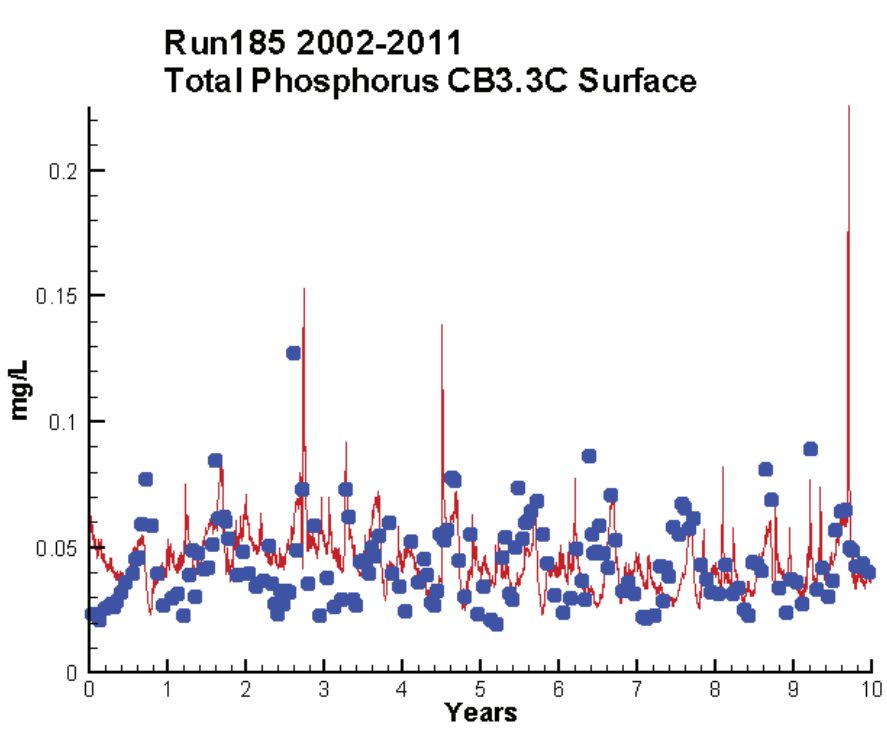




Station CB3.3C

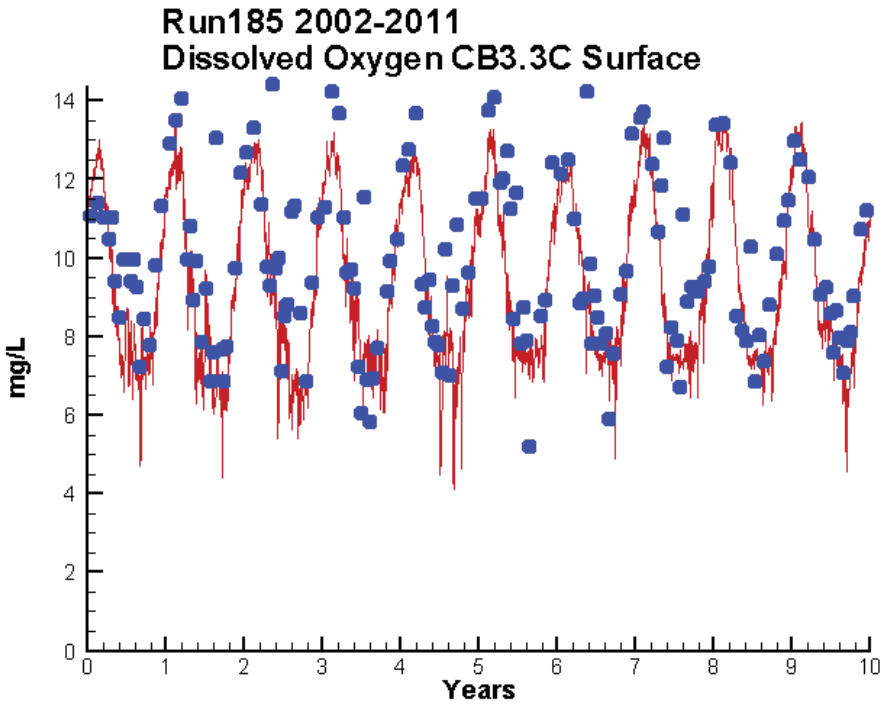


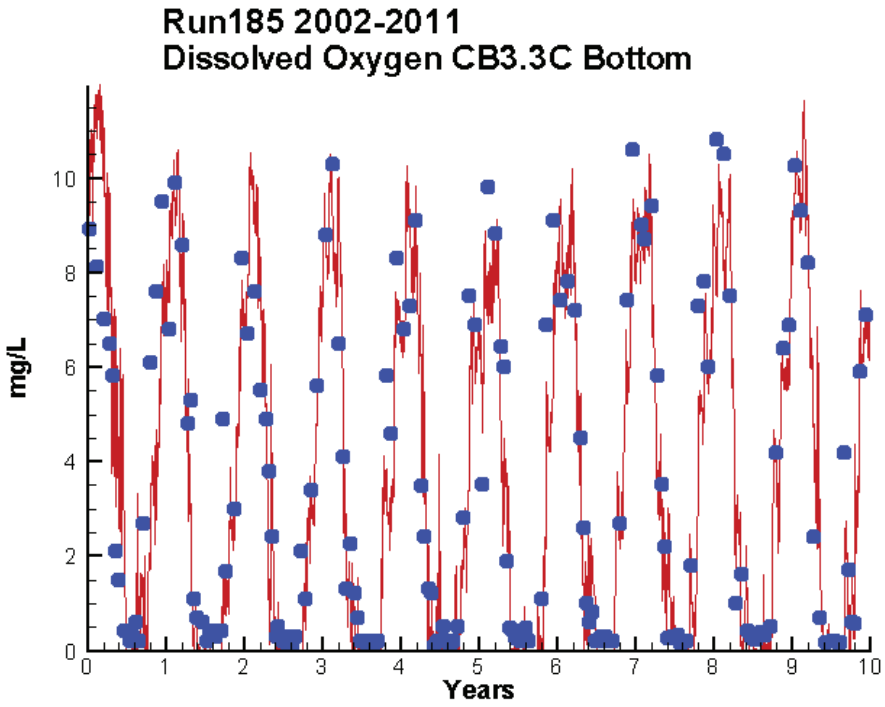


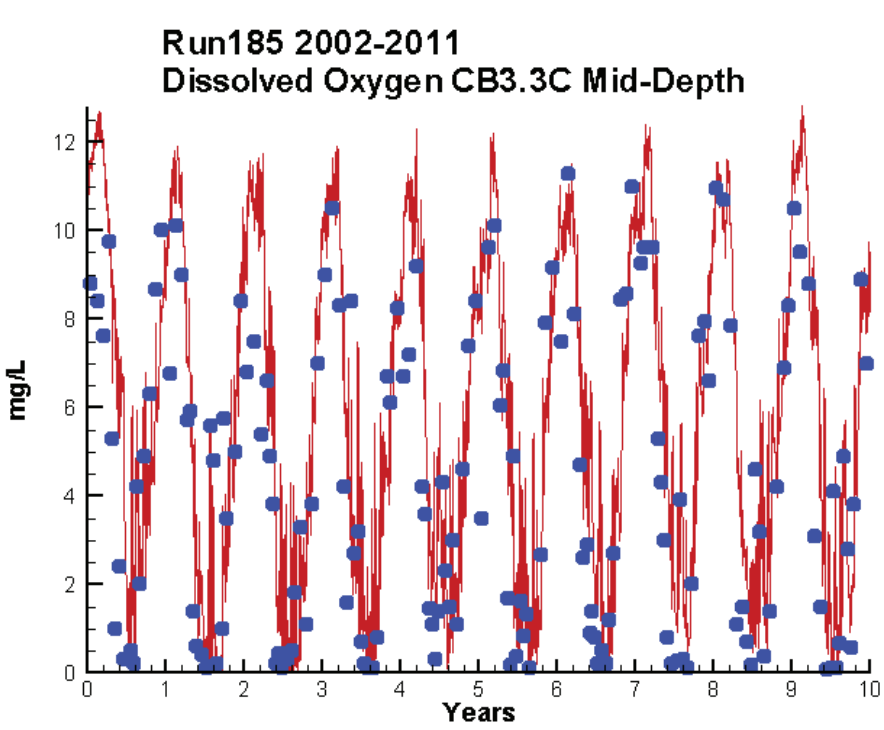


	Mean Difference	Absolute Mean Difference
Chl	-4.0477	7.8327
DIN	-0.0686	0.1789
KE	0.4751	0.5568
DIP	0.0041	0.0078
TP	0.0006	0.0128
TN	0.1086	0.1891

Station CB3.3C

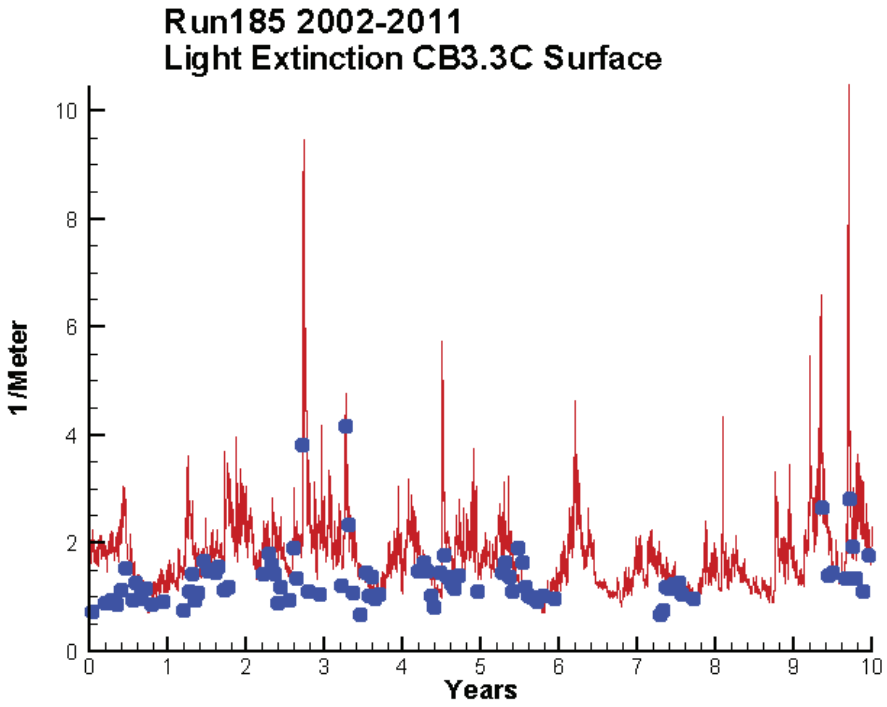


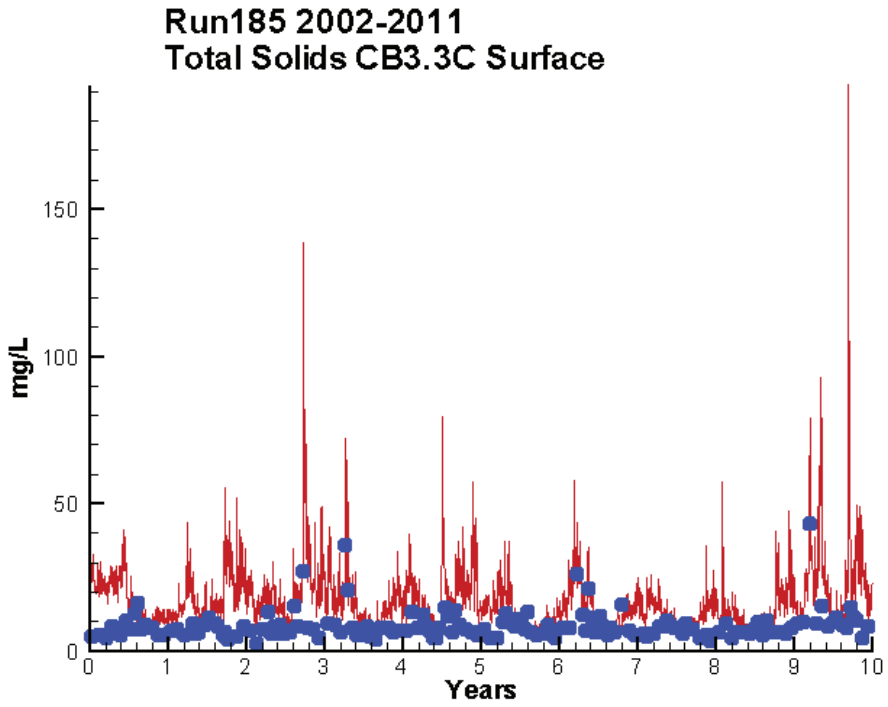


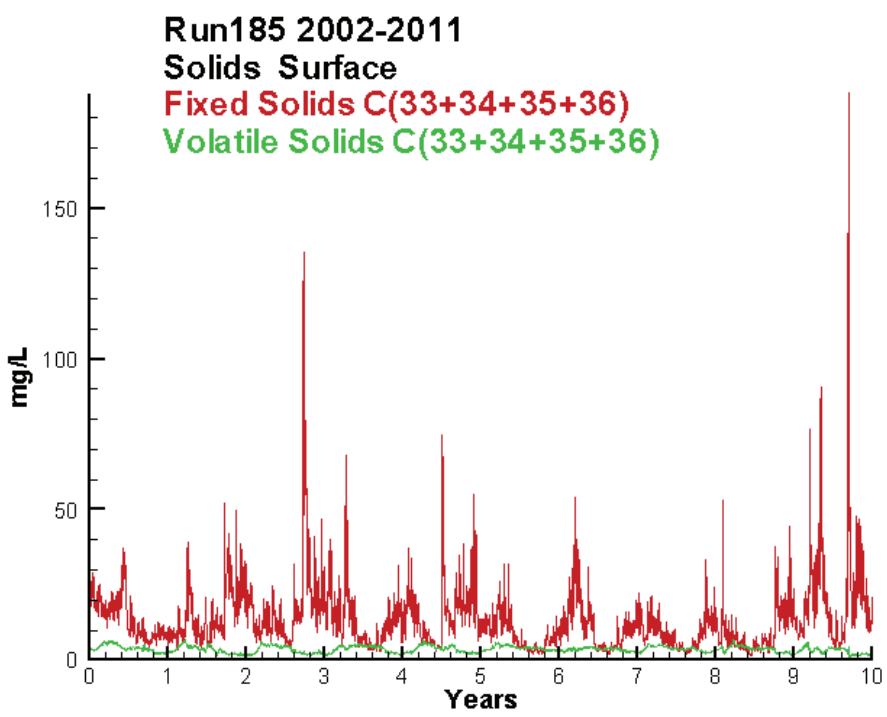


	Mean Difference	Absolute Mean Difference
Top DO	-0.7765	1.1525
Mid DO	1.0582	1.6698
Bot DO	-0.3637	0.9579

Station CB3.3C

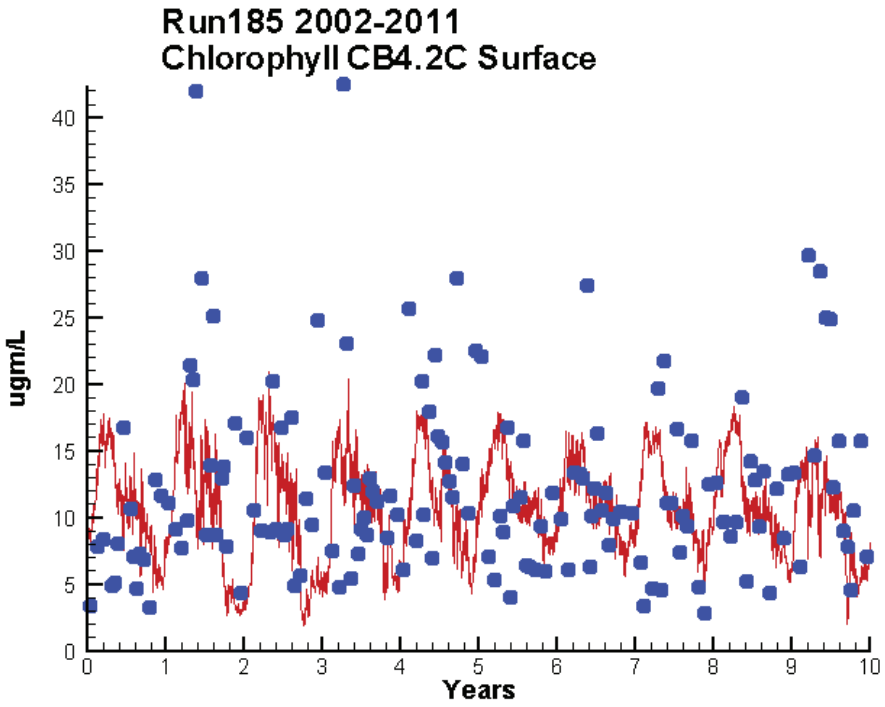


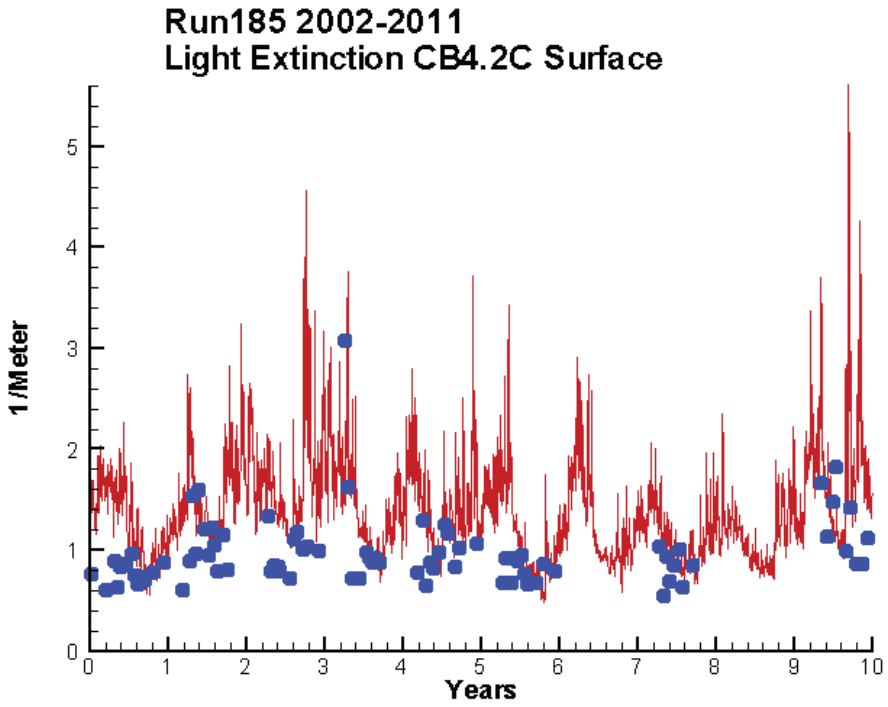


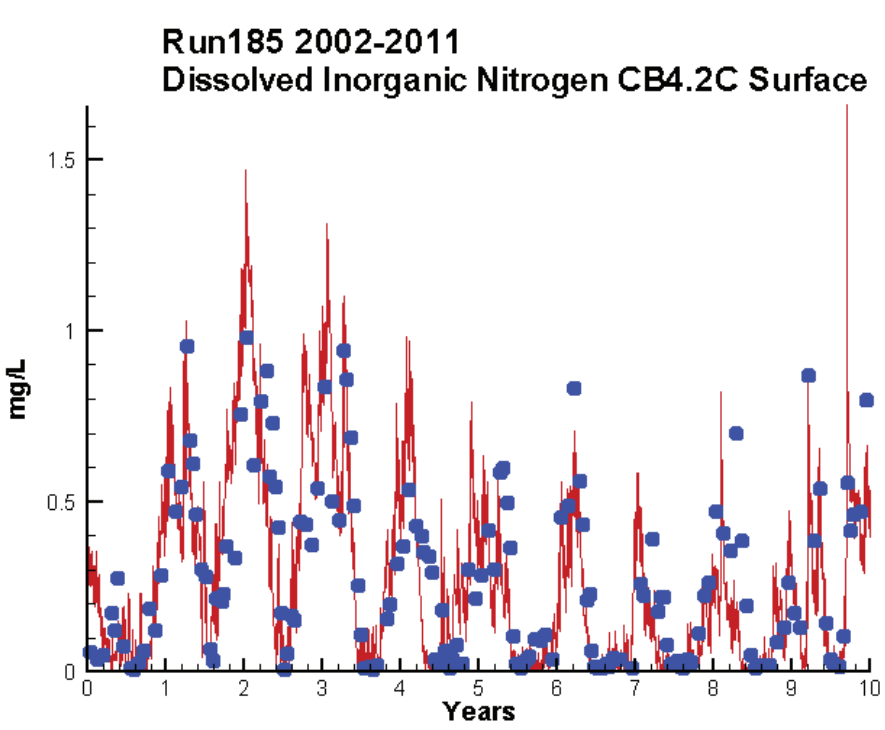


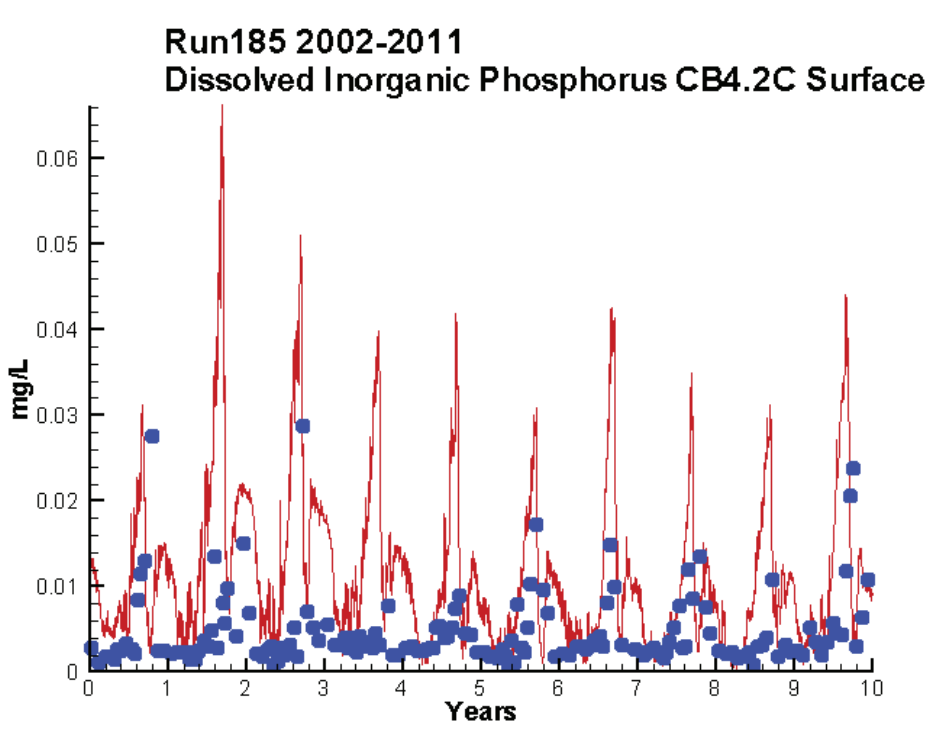
	Mean Difference	Absolute Mean Difference
KE	0.4751	0.5568
TSS	7.8652	8.2521

Station CB4.2C

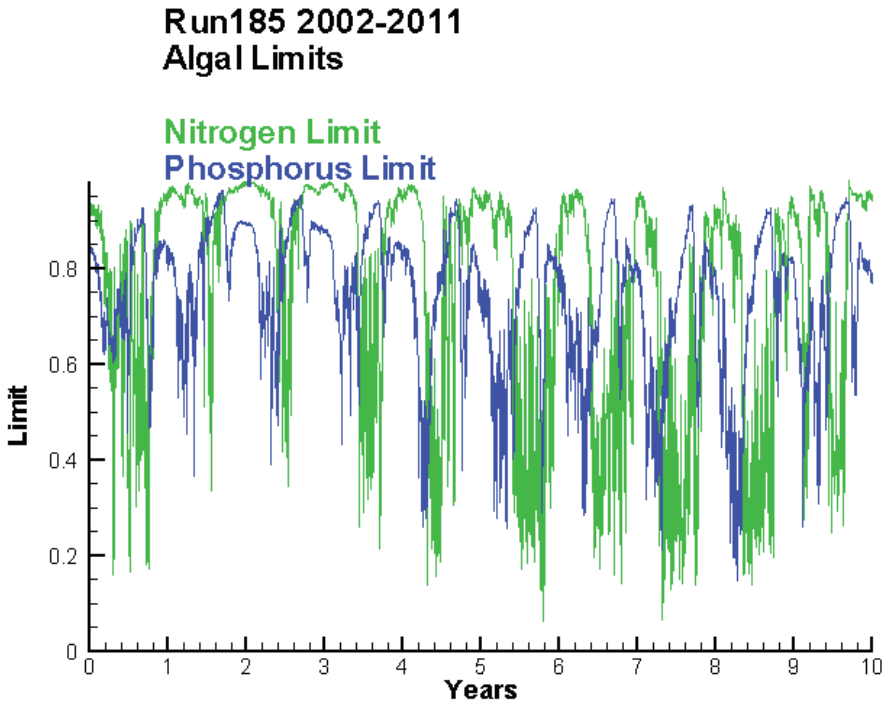


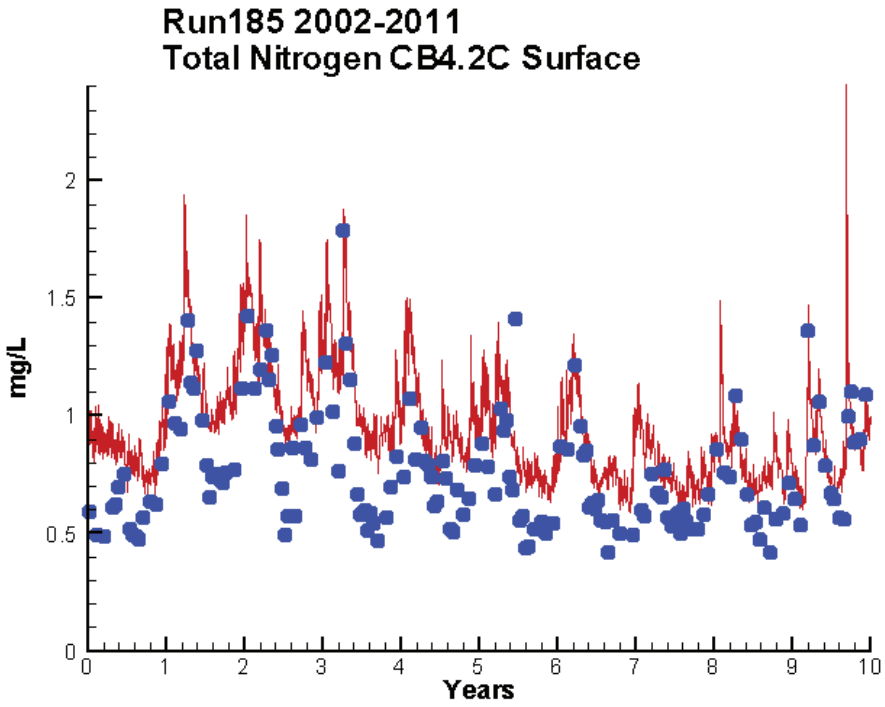


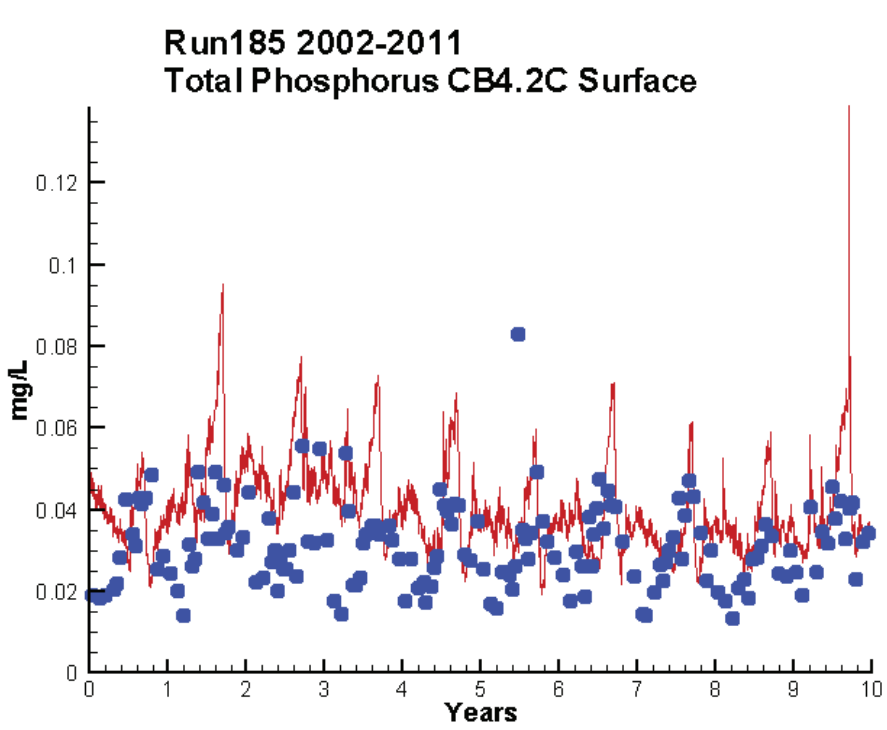




Station CB4.2C

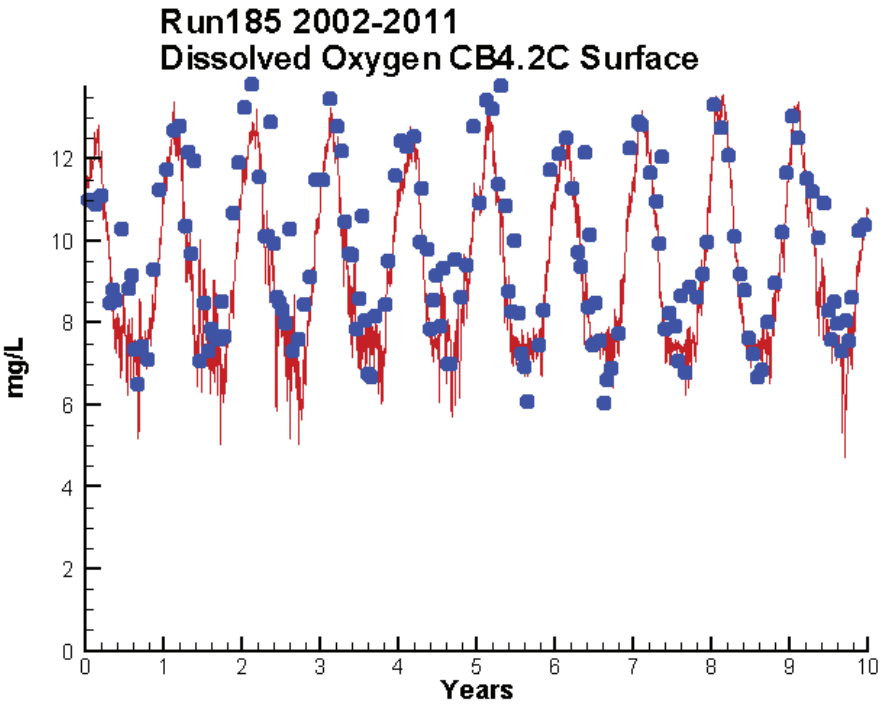


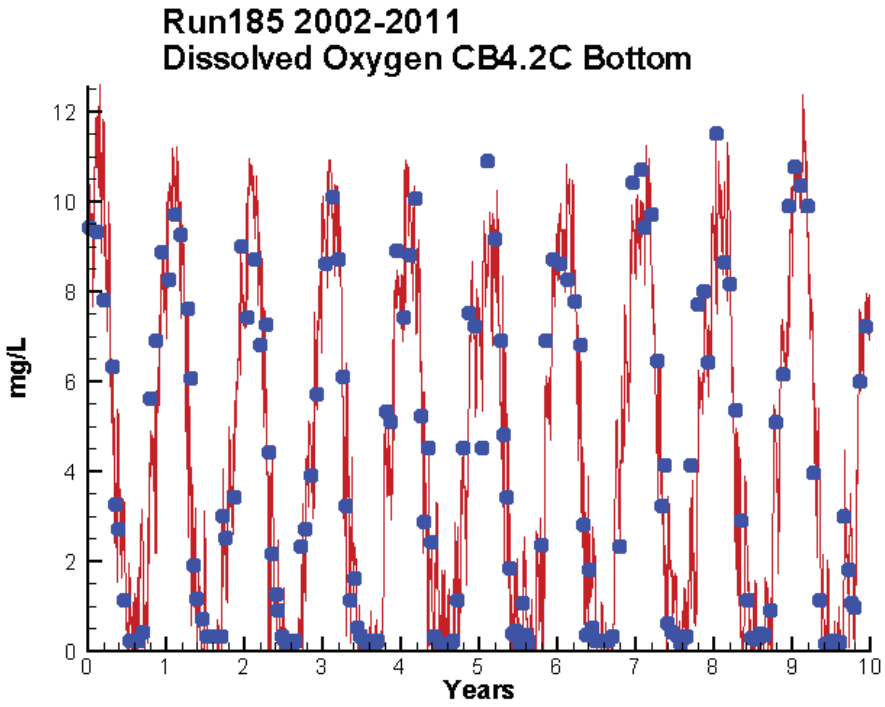


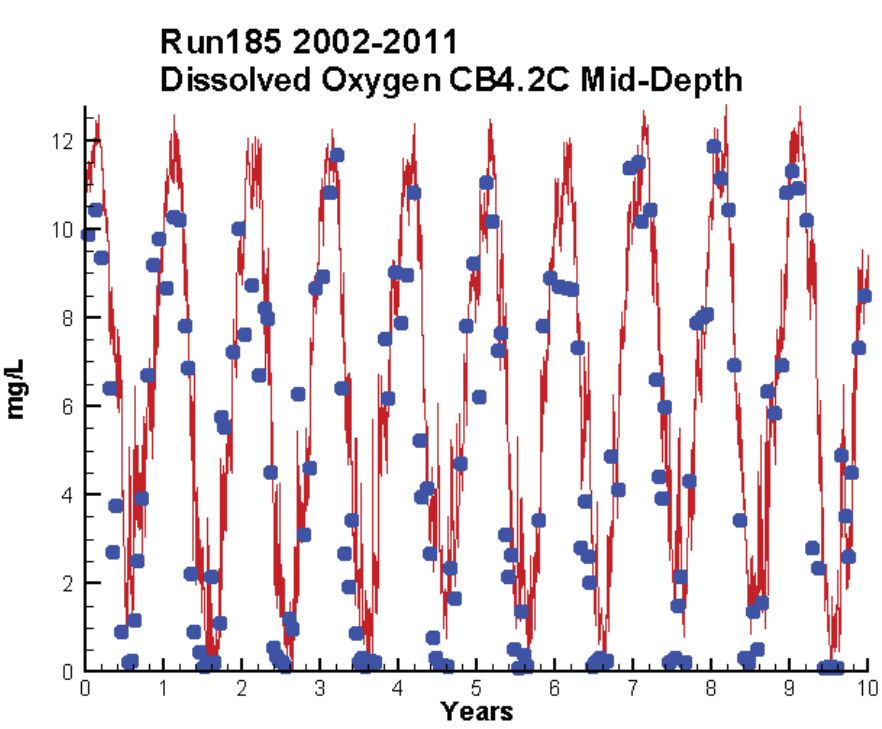


	Mean Difference	Absolute Mean Difference
Chl	-0.9771	5.7475
DIN	-0.0281	0.1273
KE	0.3955	0.4571
DIP	0.0070	0.0081
TP	0.0096	0.0128
TN	0.1787	0.2004

Station CB4.2C

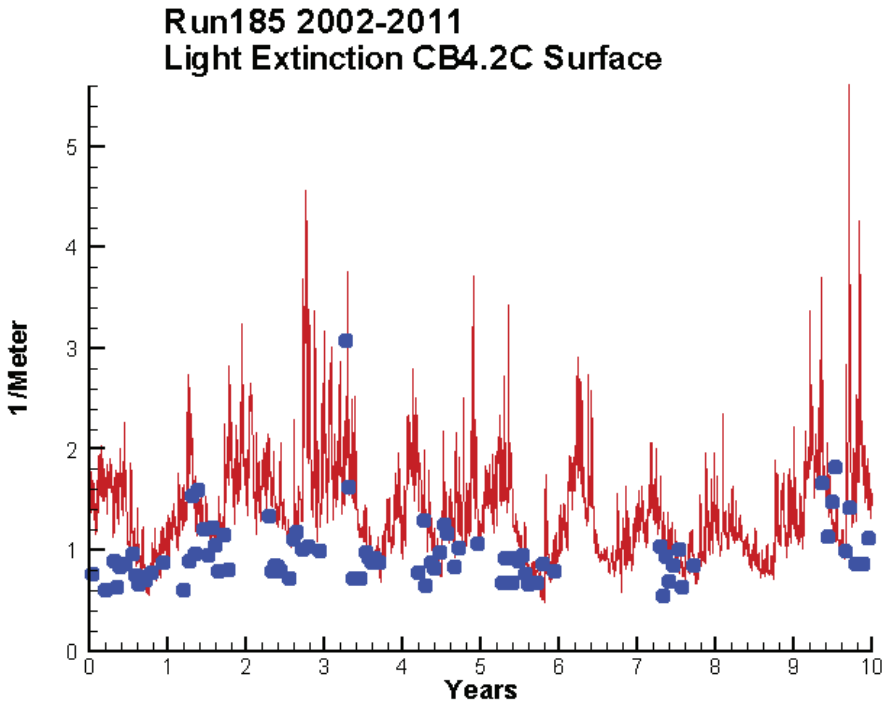


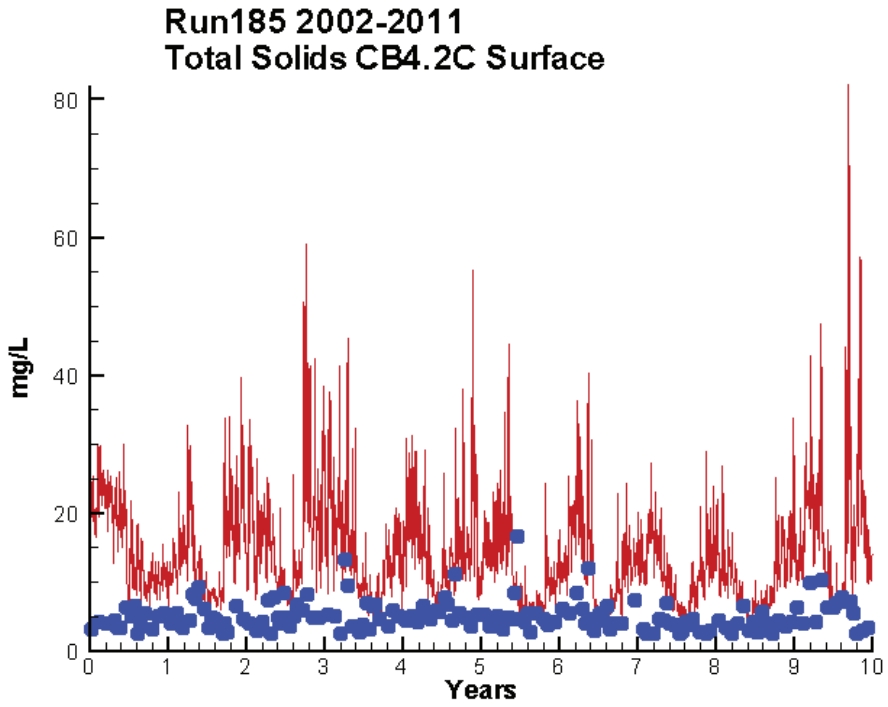


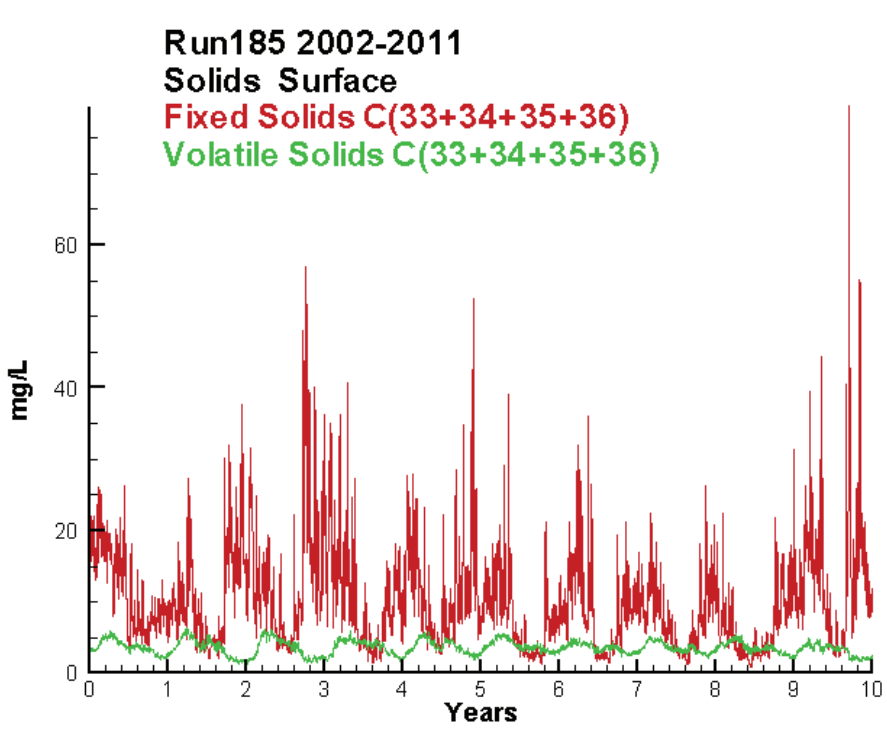


	Mean Difference	Absolute Mean Difference
Top DO	-0.5847	0.8599
Mid DO	1.1654	1.5393
Bot DO	-0.0977	0.9229

Station CB4.2C

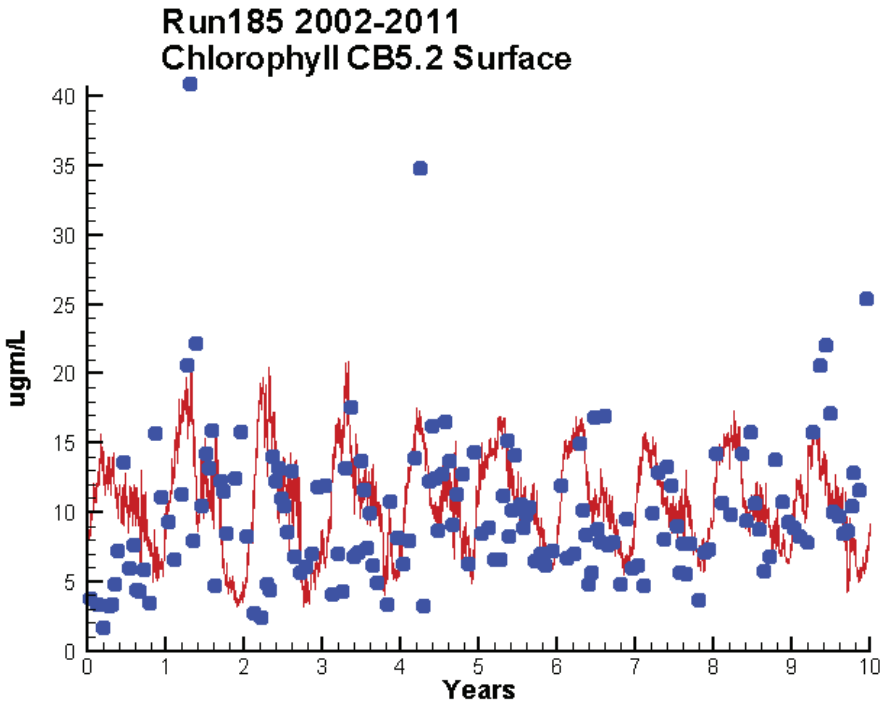


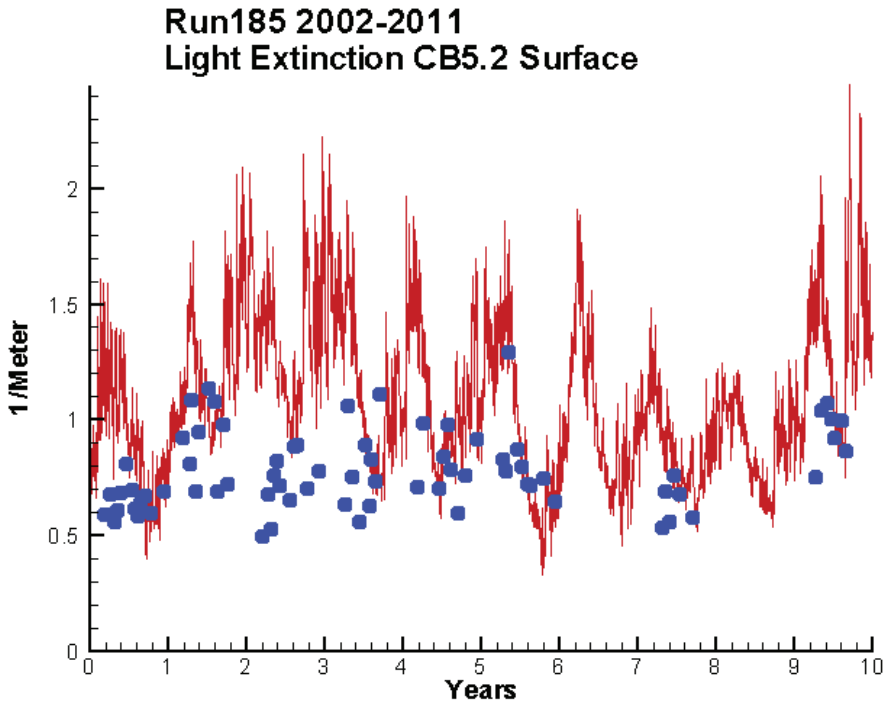


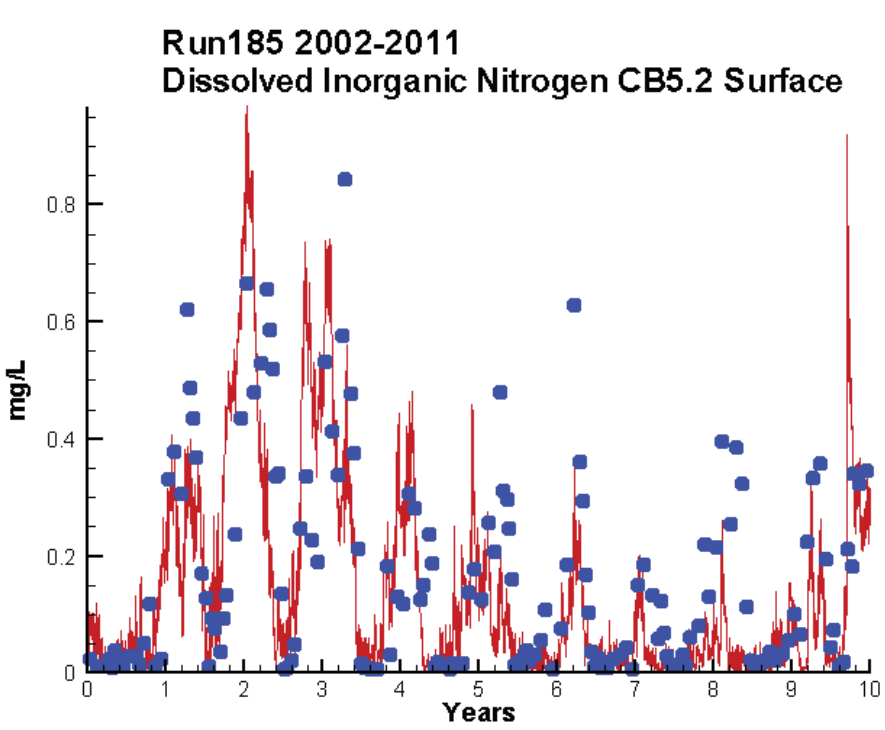


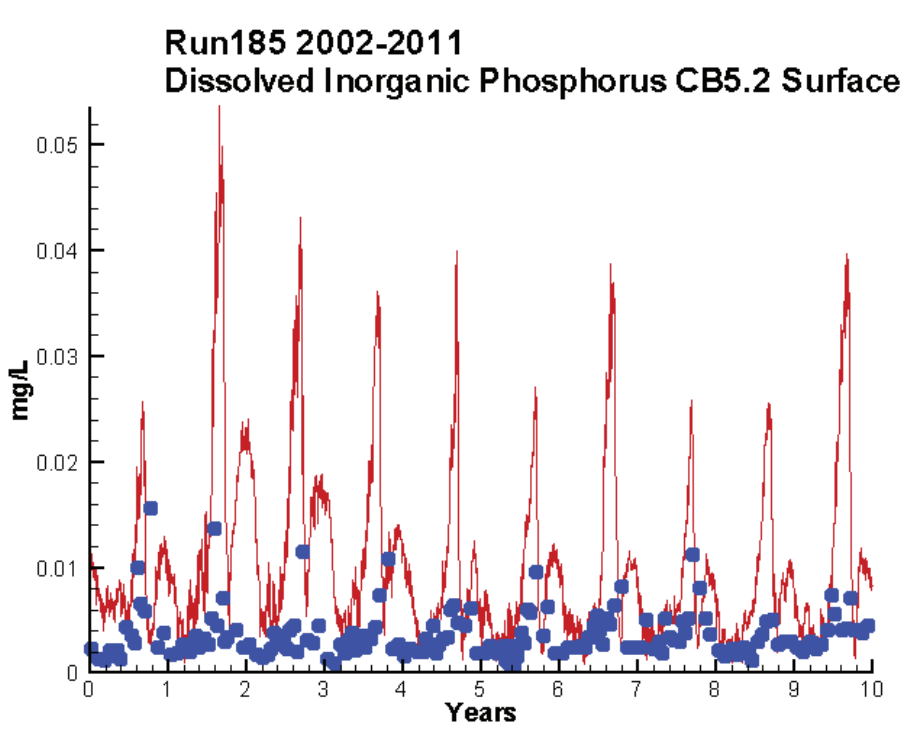
	Mean Difference	Absolute Mean Difference
KE	0.3955	0.4571
TSS	7.7778	7.9436

Station CB5.2

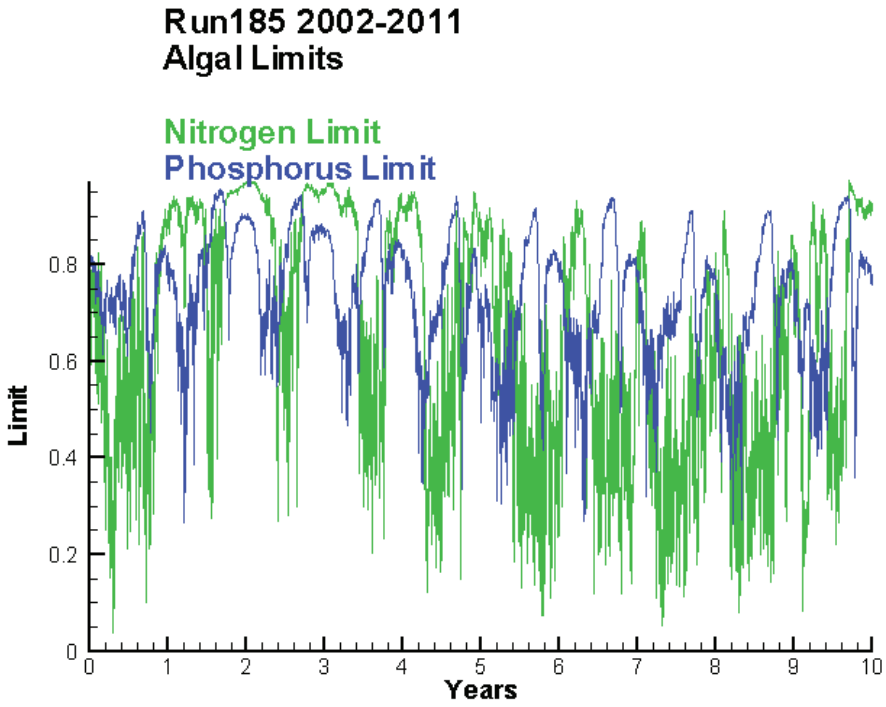


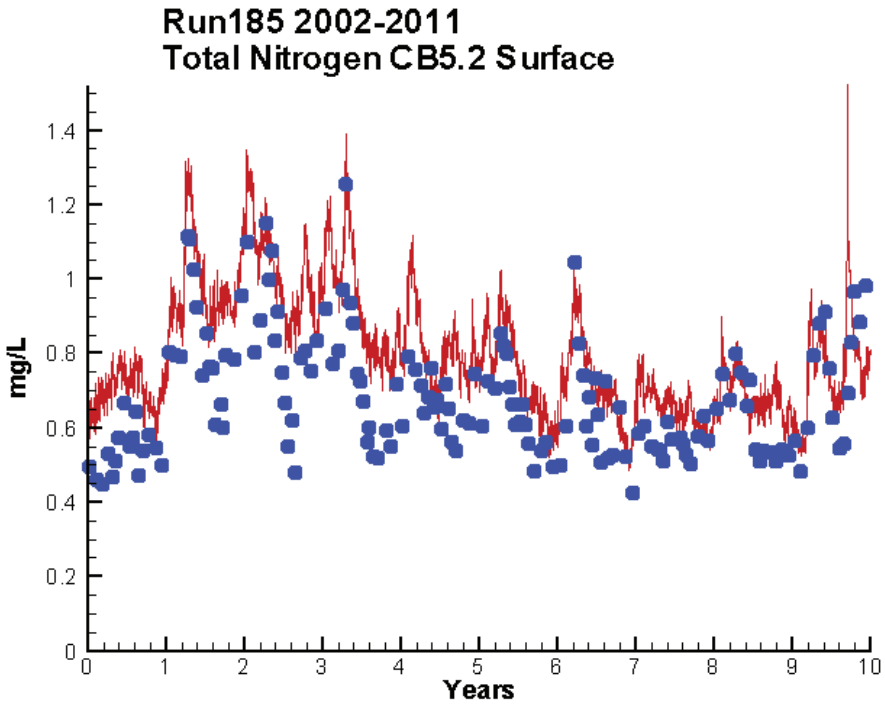


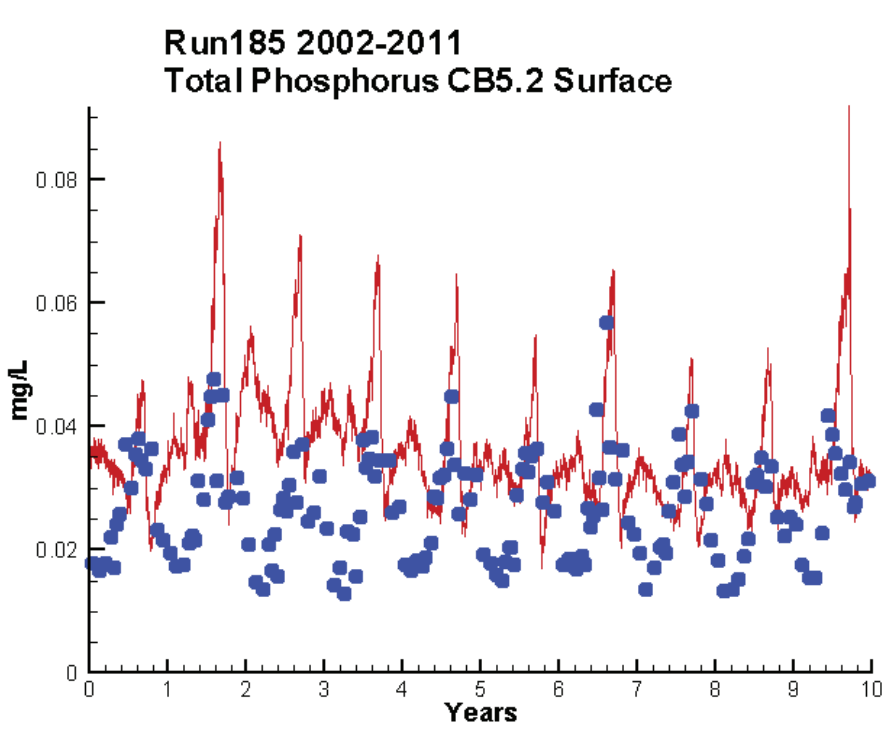




Station CB5.2

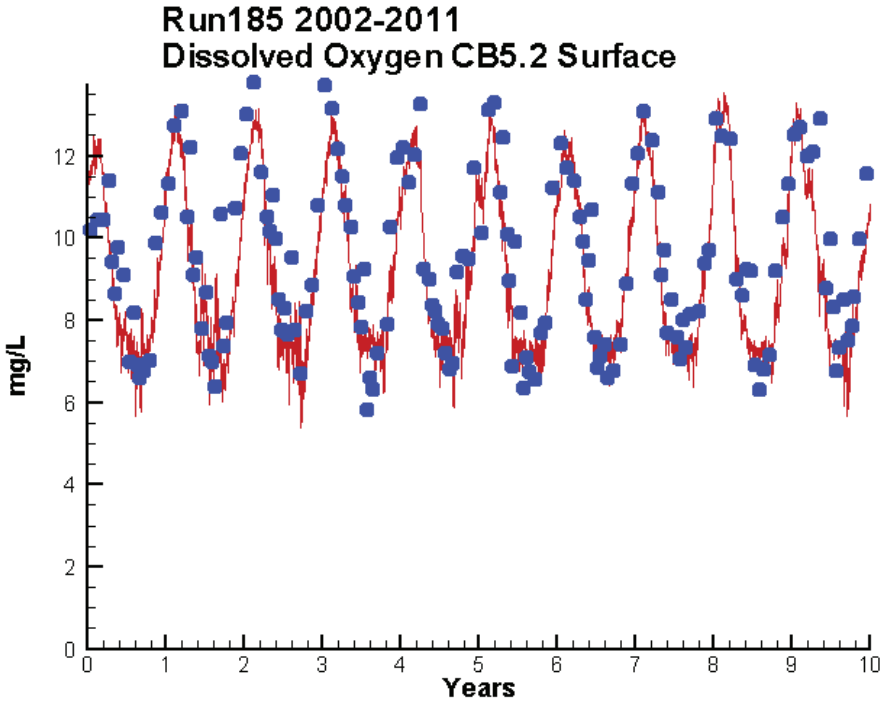


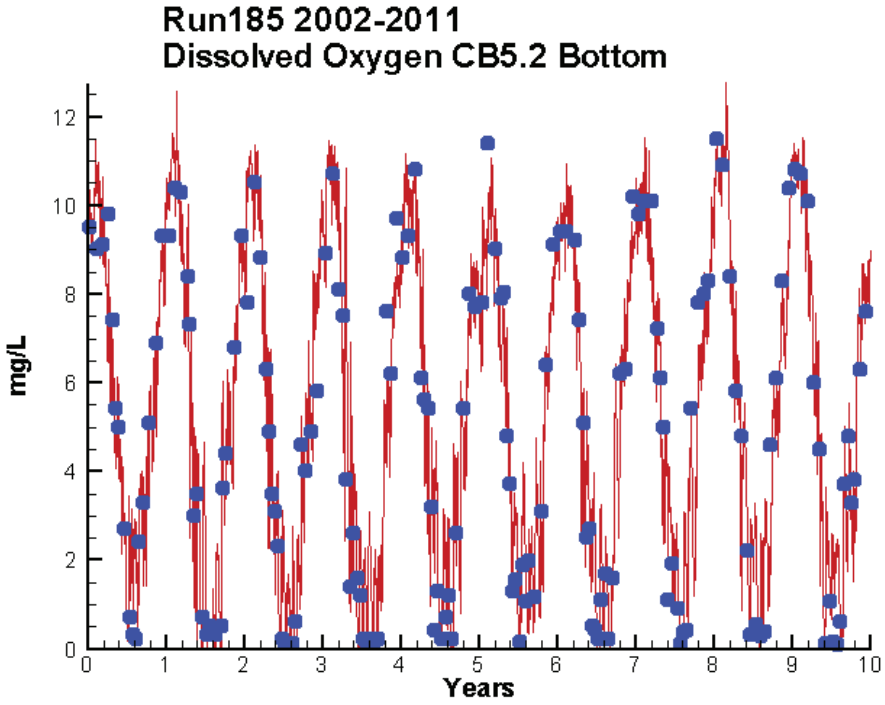


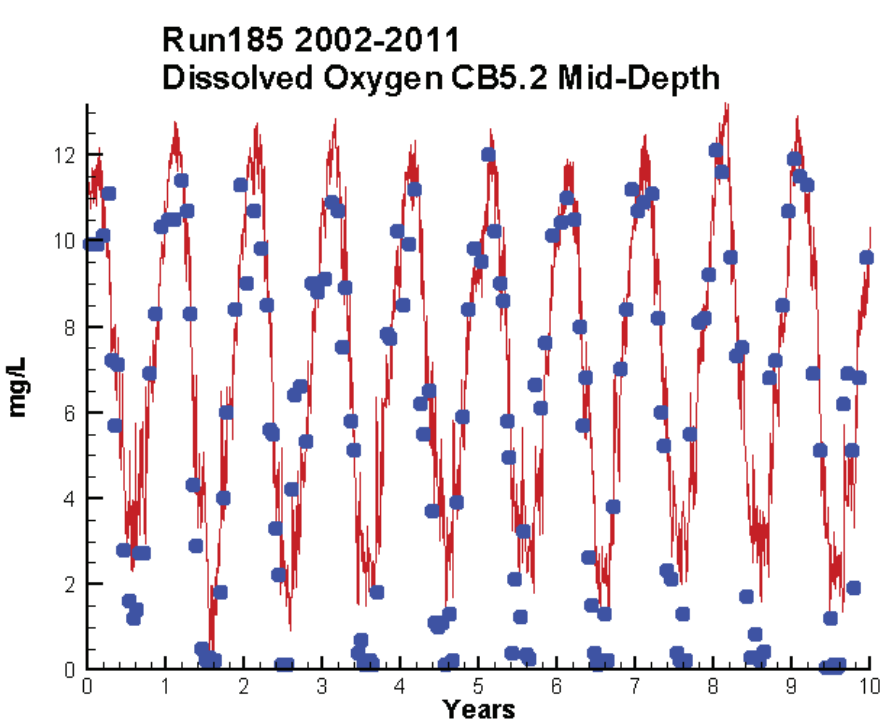


	Mean Difference	Absolute Mean Difference
Chl	1.0630	4.5450
DIN	-0.0307	0.1015
KE	0.3105	0.3465
DIP	0.0070	0.0073
TP	0.0105	0.0121
TN	0.1278	0.1422

Station CB5.2

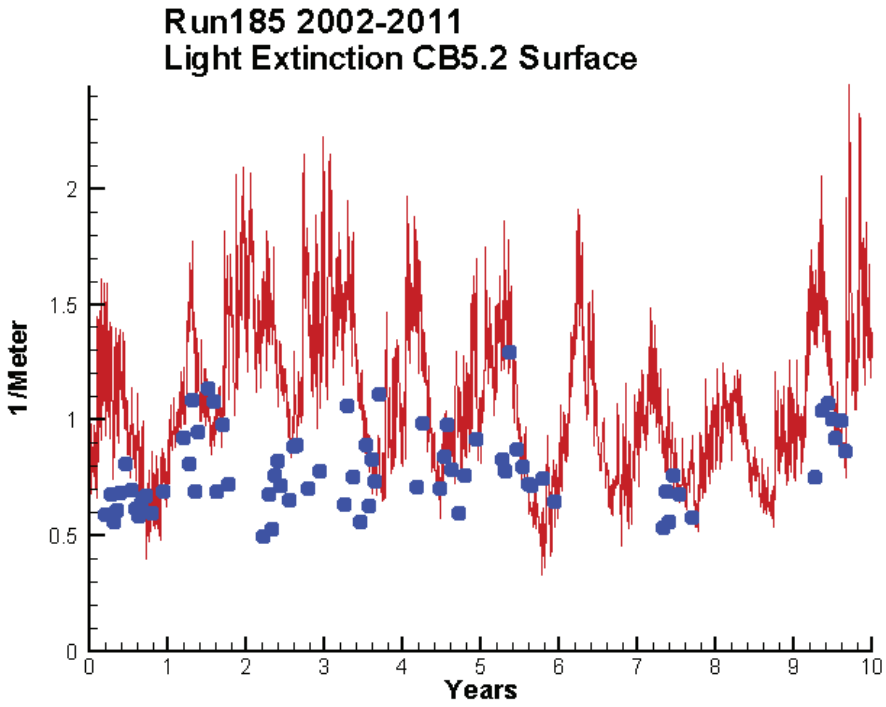


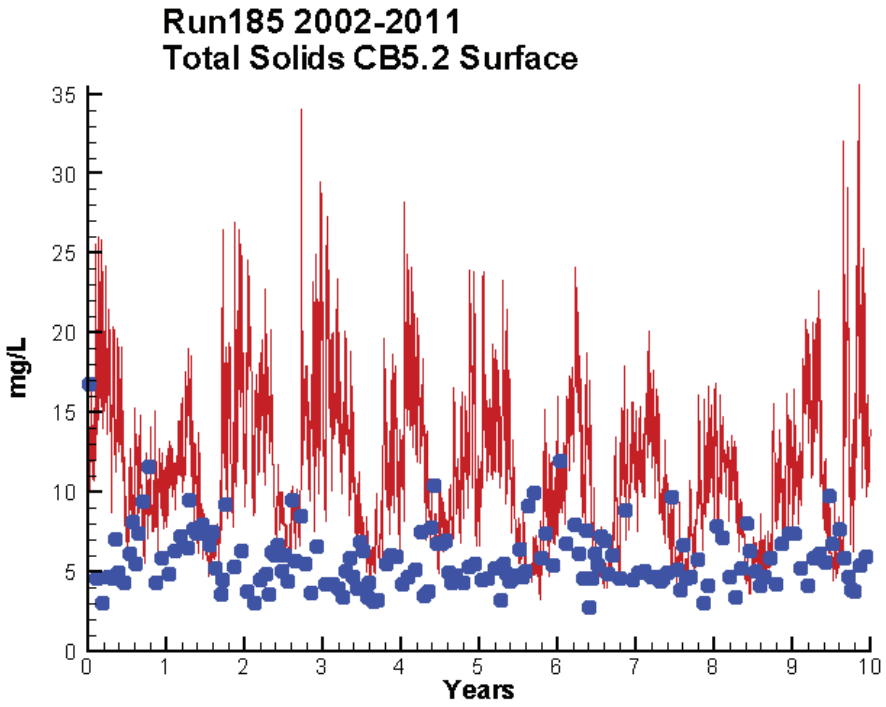


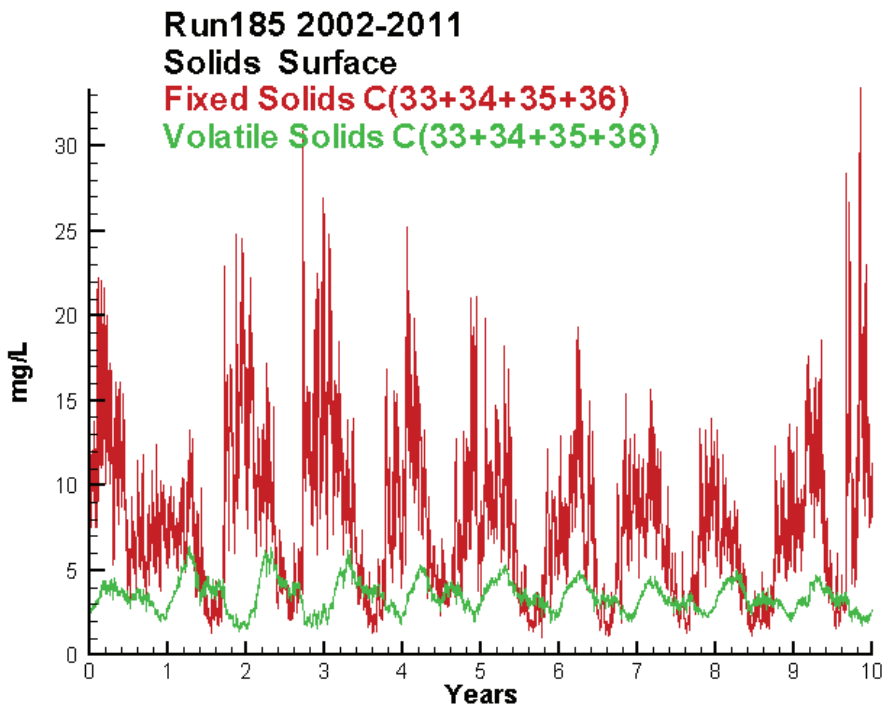


	Mean Difference	Absolute Mean Difference
Top DO	-0.4957	0.8217
Mid DO	0.9937	1.4417
Bot DO	0.2076	1.0517

Station CB5.2

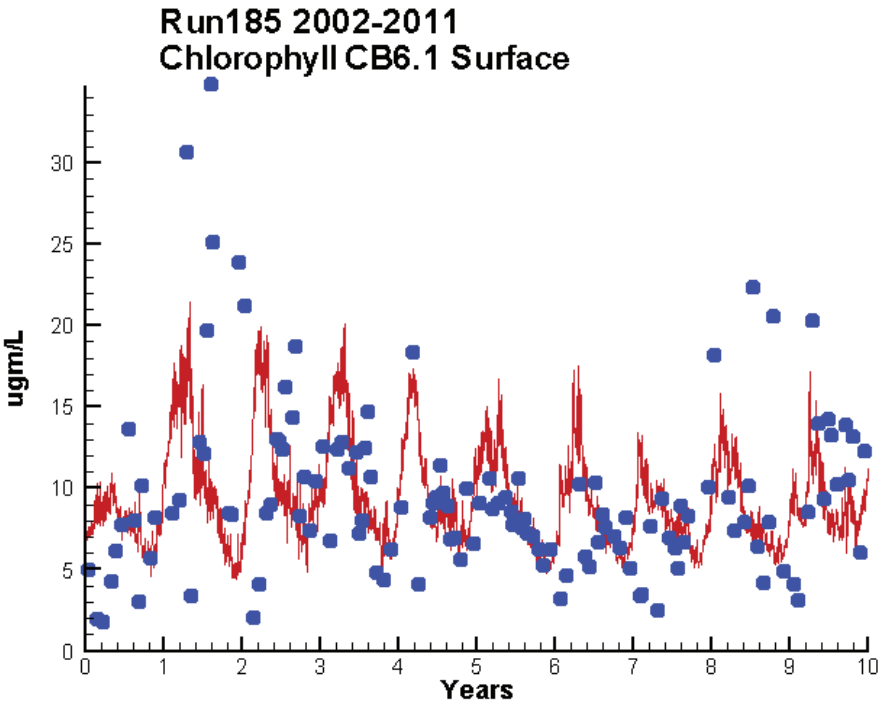


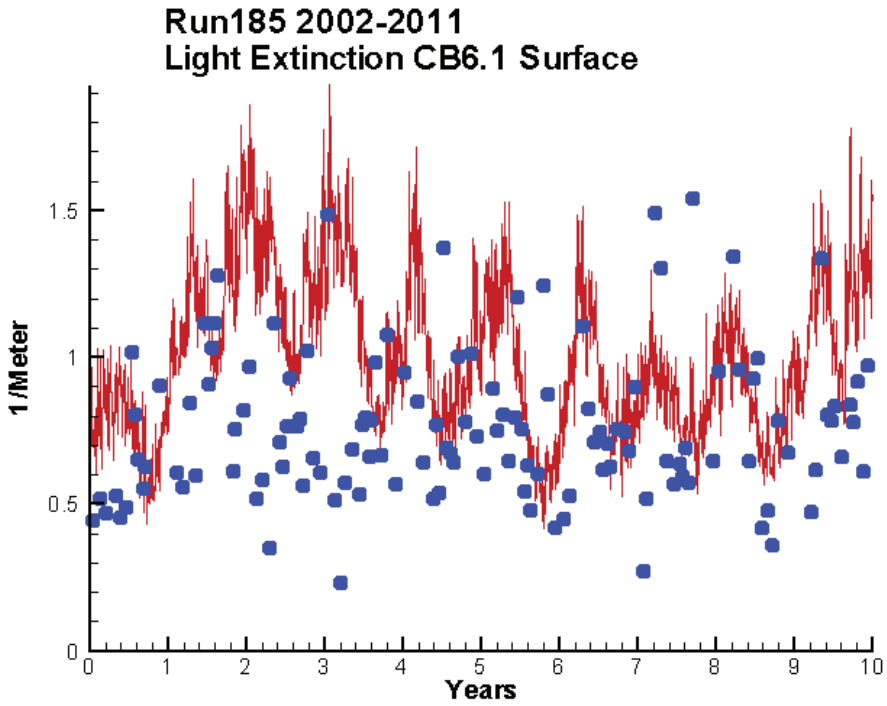


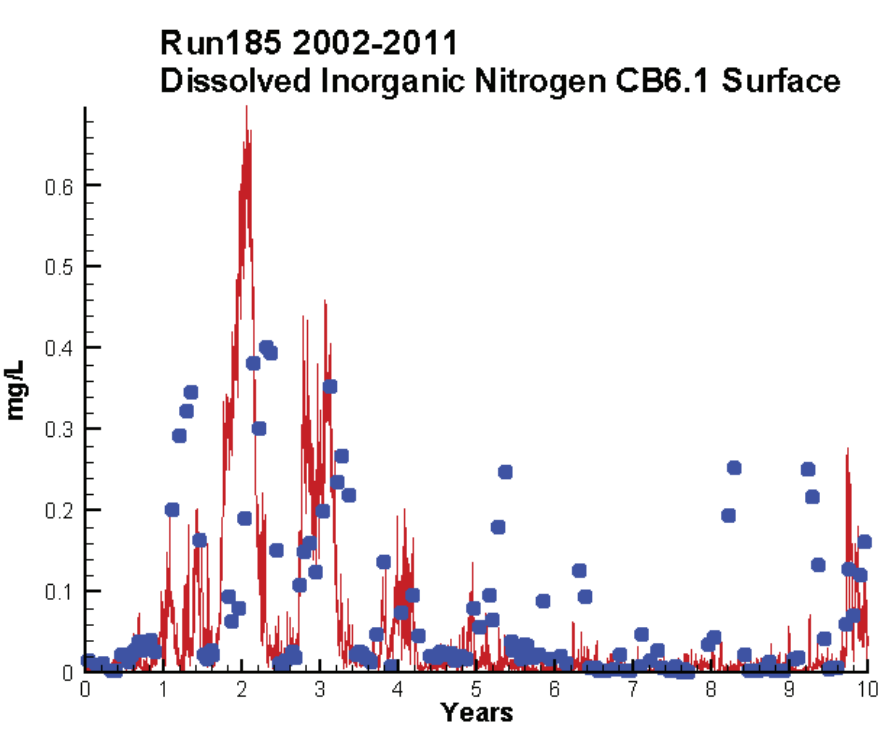


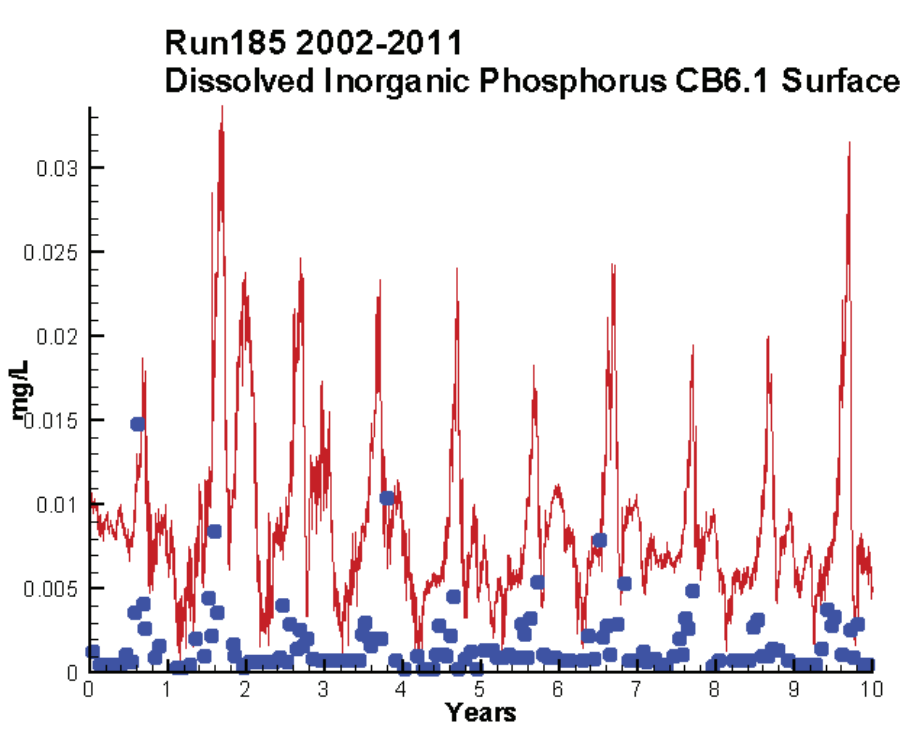
	Mean Difference	Absolute Mean Difference
KE	0.3105	0.3465
TSS	5.0781	5.4897

Station CB6.1

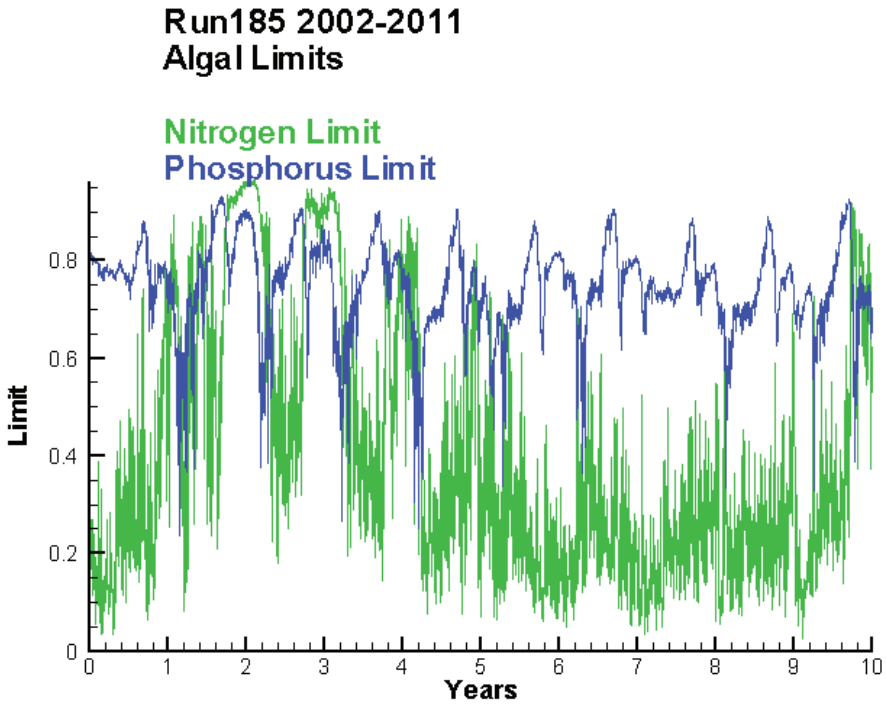


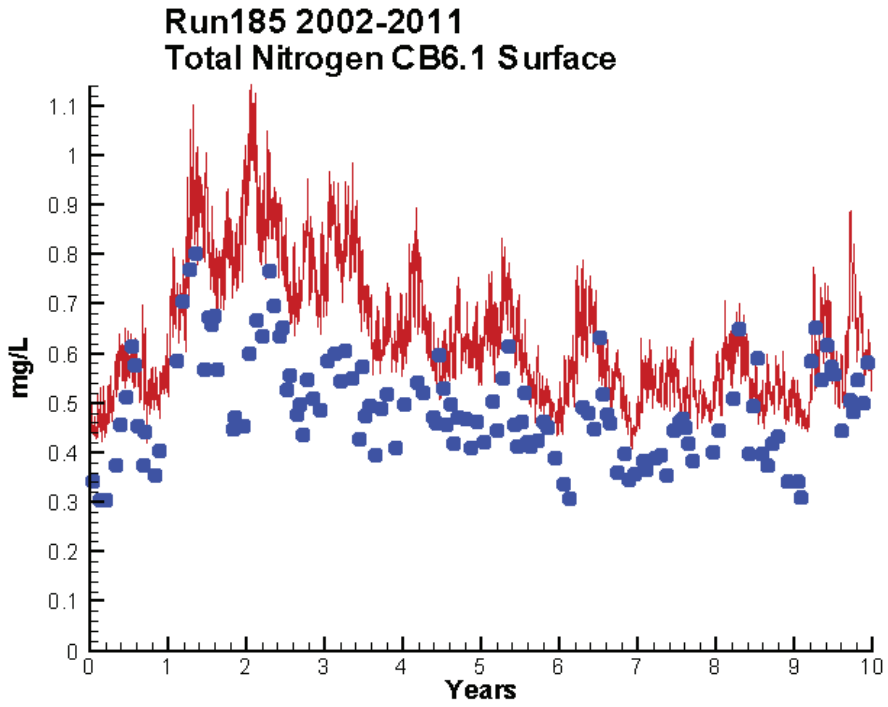


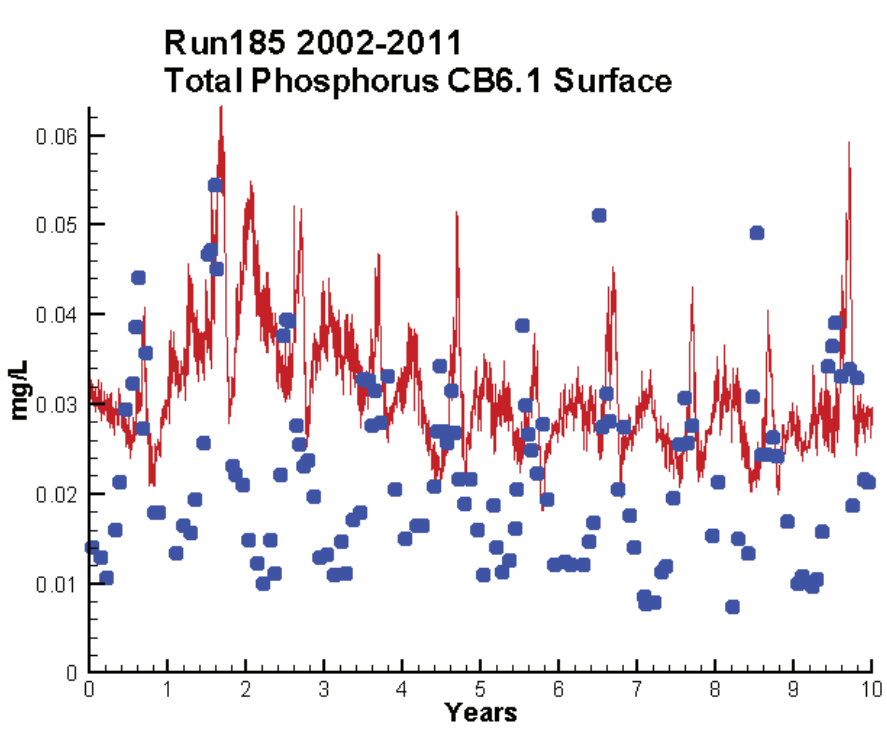




Station CB6.1

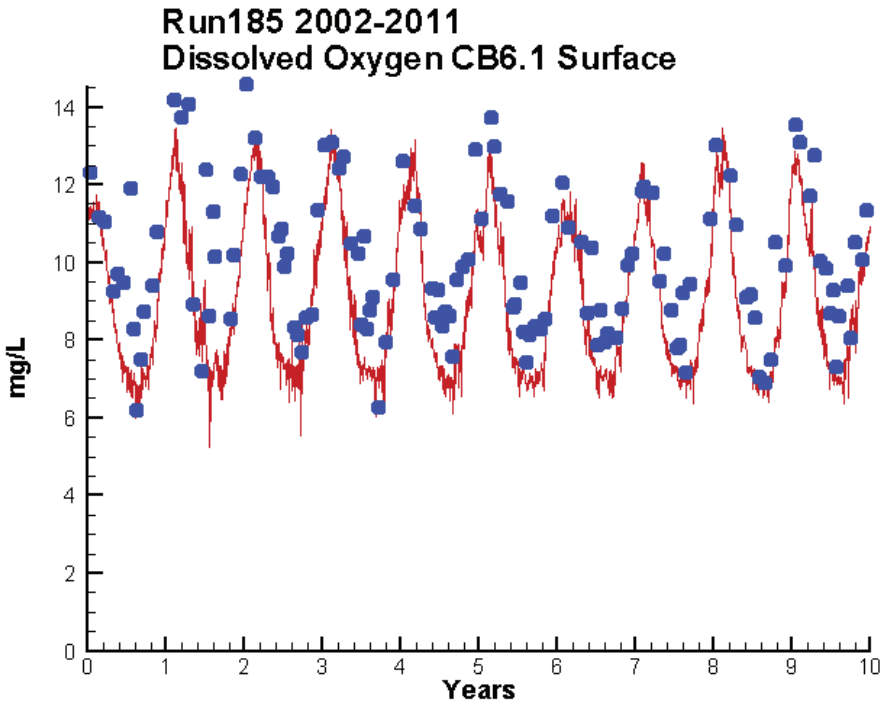


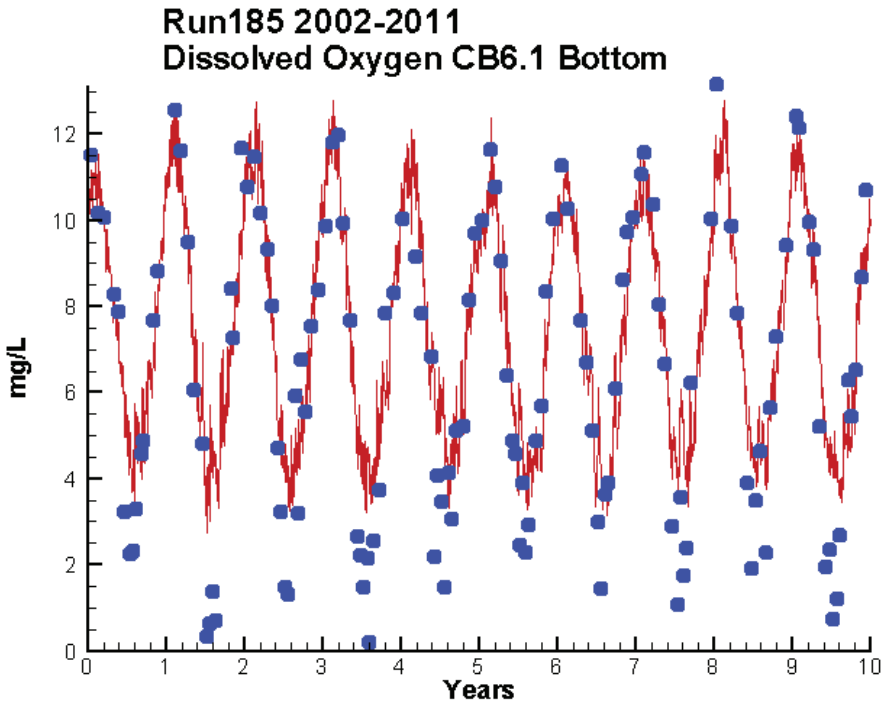


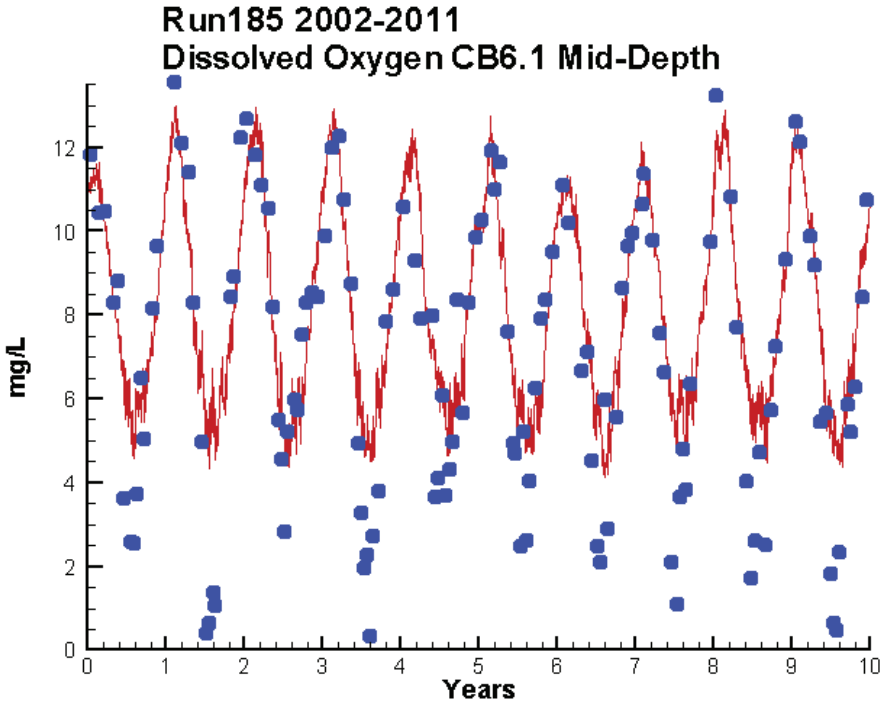


	Mean Difference	Absolute Mean Difference
Chl	-0.0356	4.0112
DIN	-0.0241	0.0615
KE	0.2391	0.3206
DIP	0.0074	0.0075
TP	0.0089	0.0121
TN	0.1572	0.1625

Station CB6.1

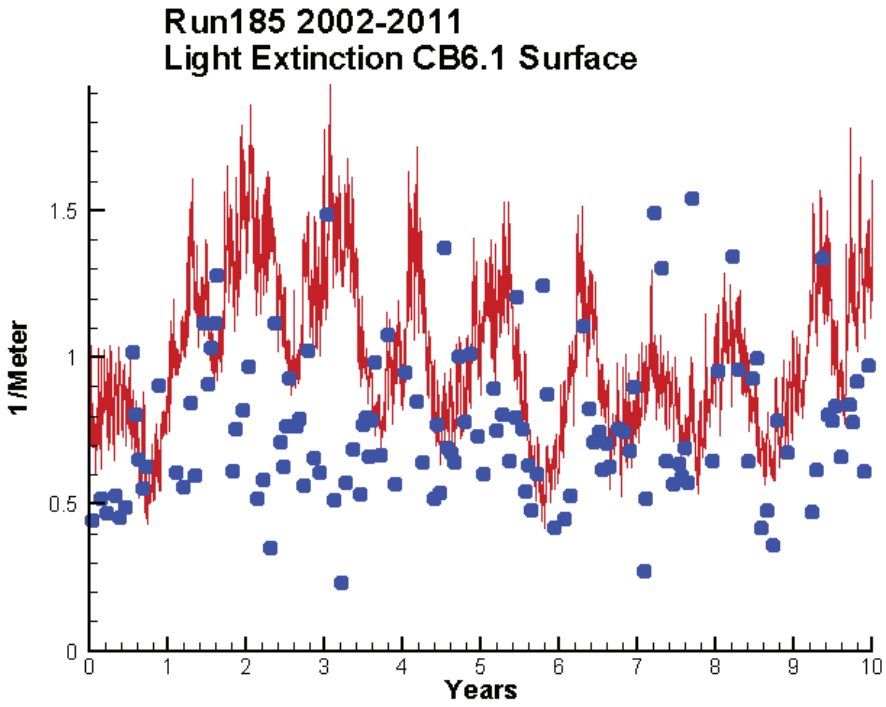


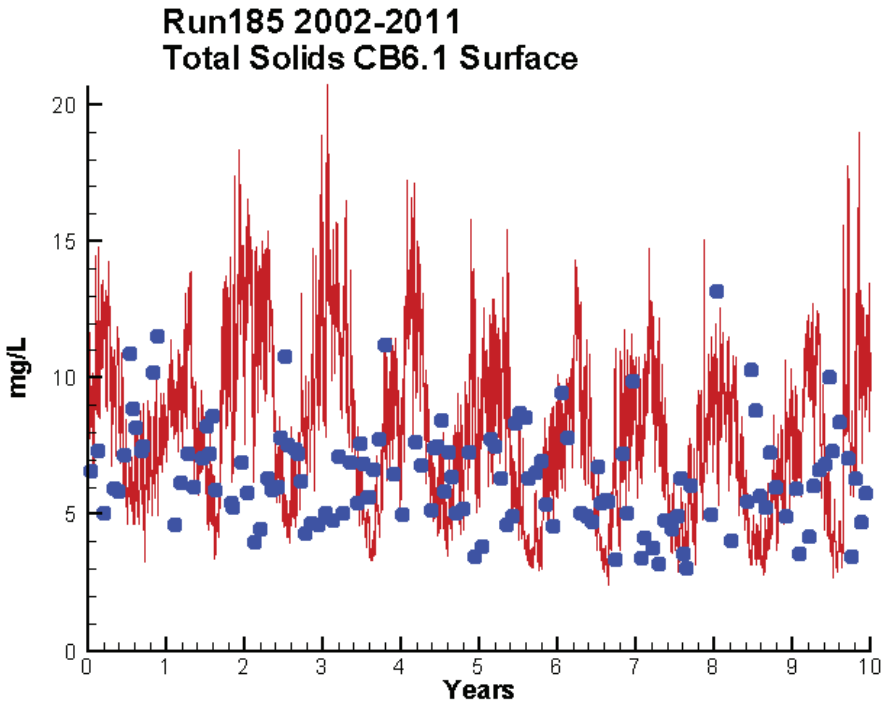


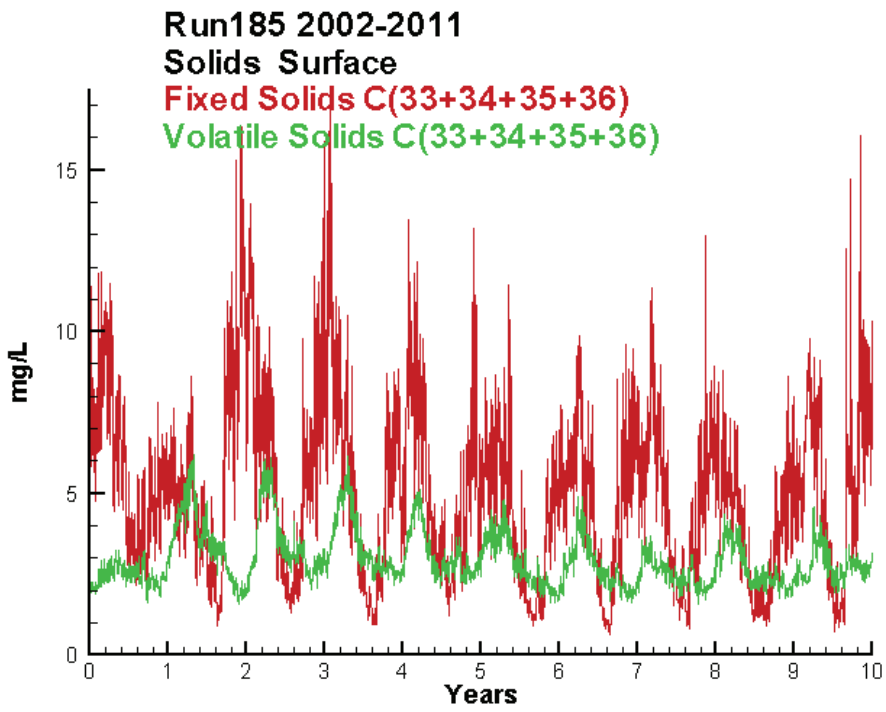


	Mean Difference	Absolute Mean Difference
Top DO	-1.2377	1.3502
Mid DO	0.8870	1.4135
Bot DO	0.5699	1.2290

Station CB6.1

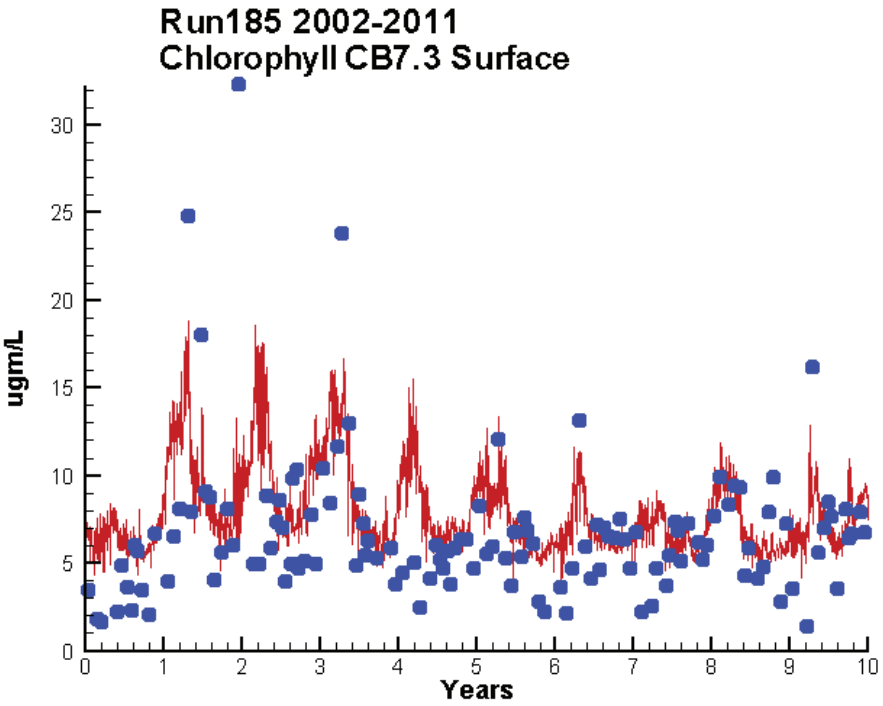


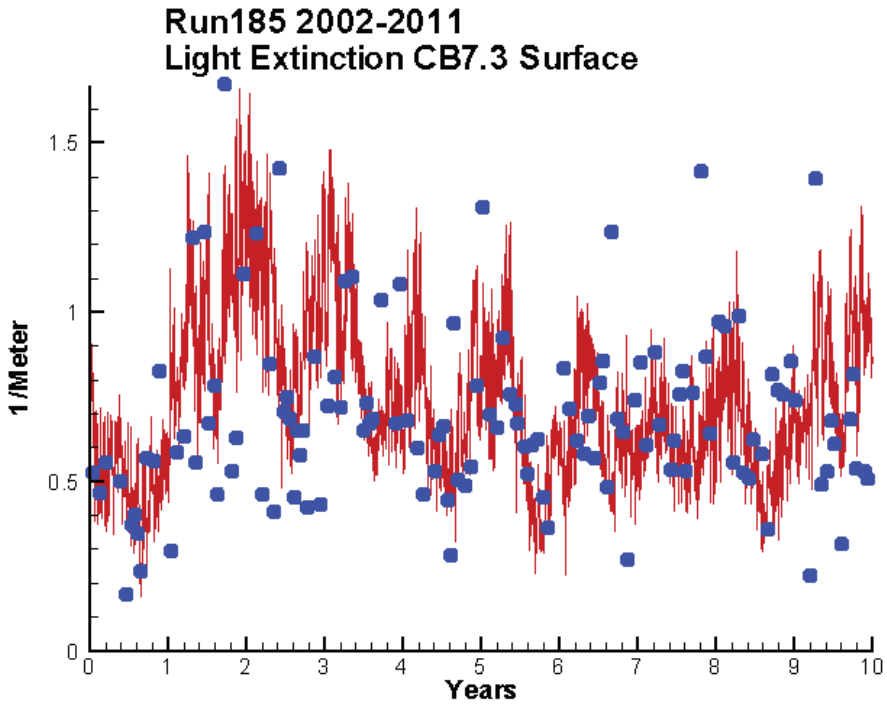


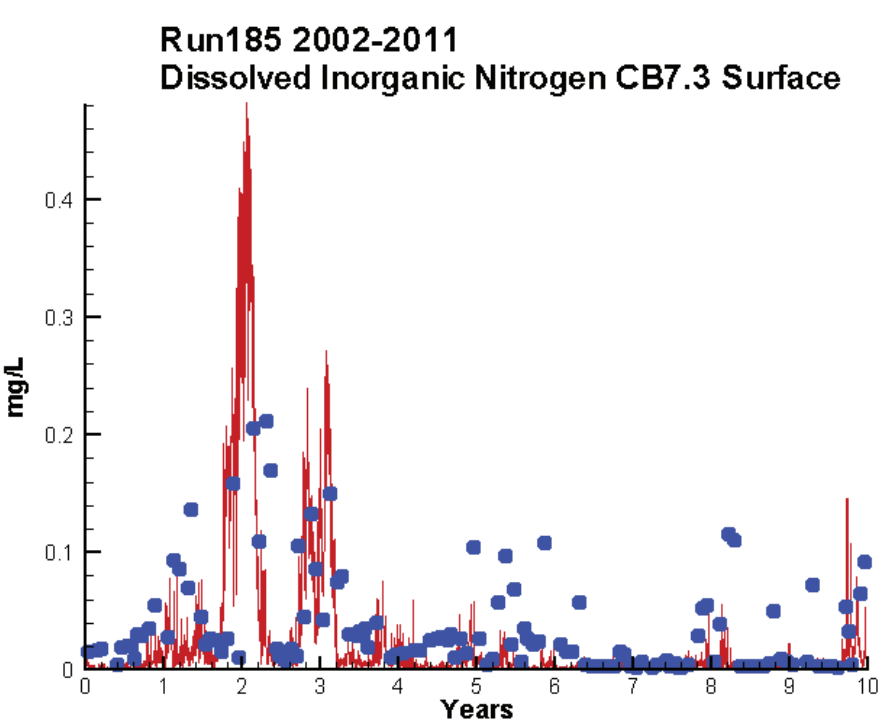


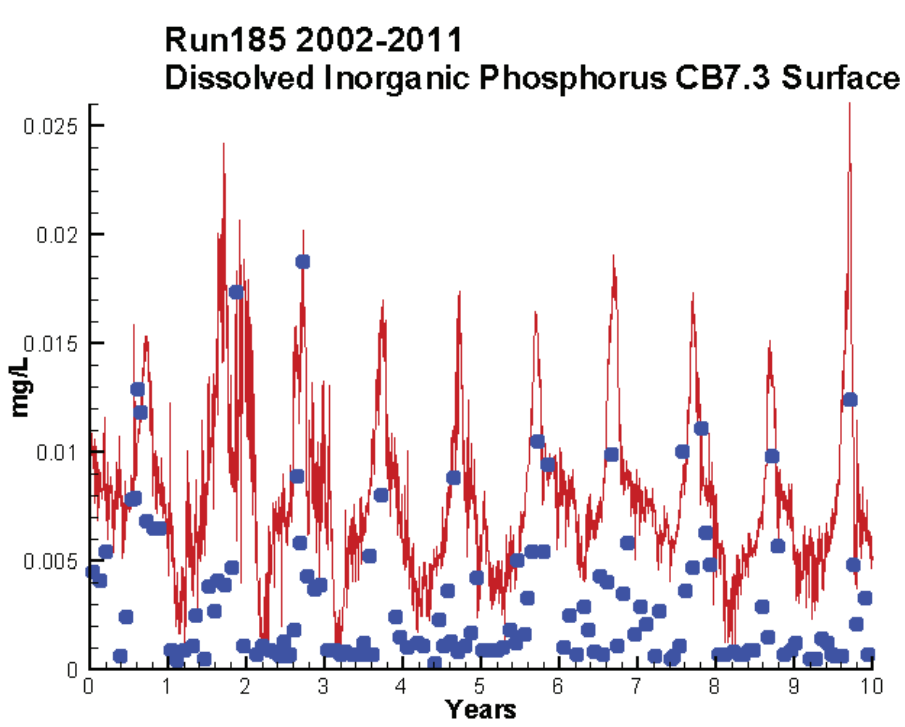
	Mean Difference	Absolute Mean Difference
KE	0.2391	0.3206
TSS	0.8555	2.8918

Station CB7.3

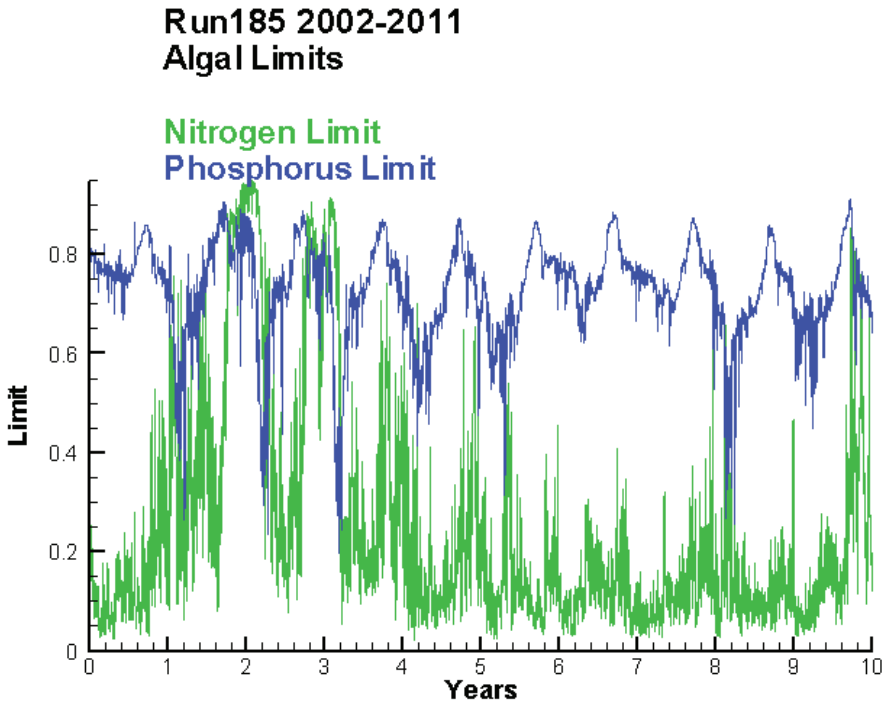


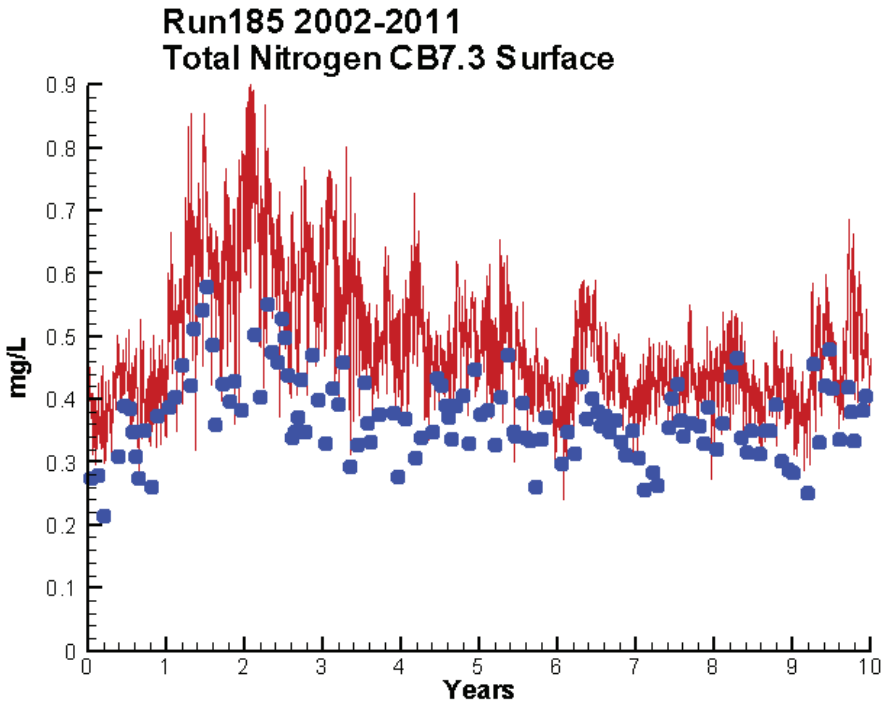


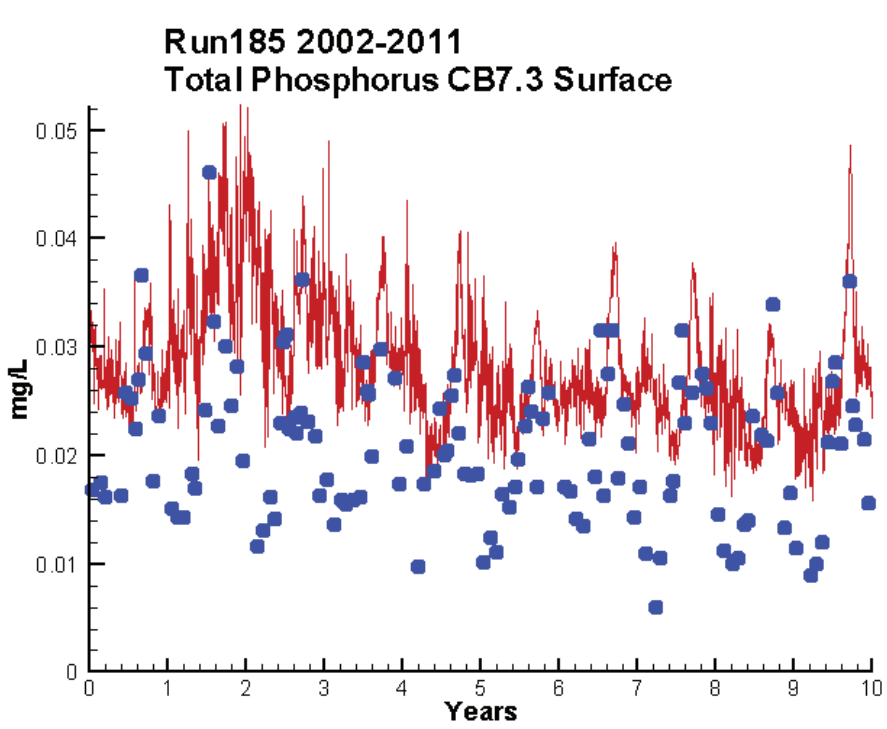




Station CB7.3

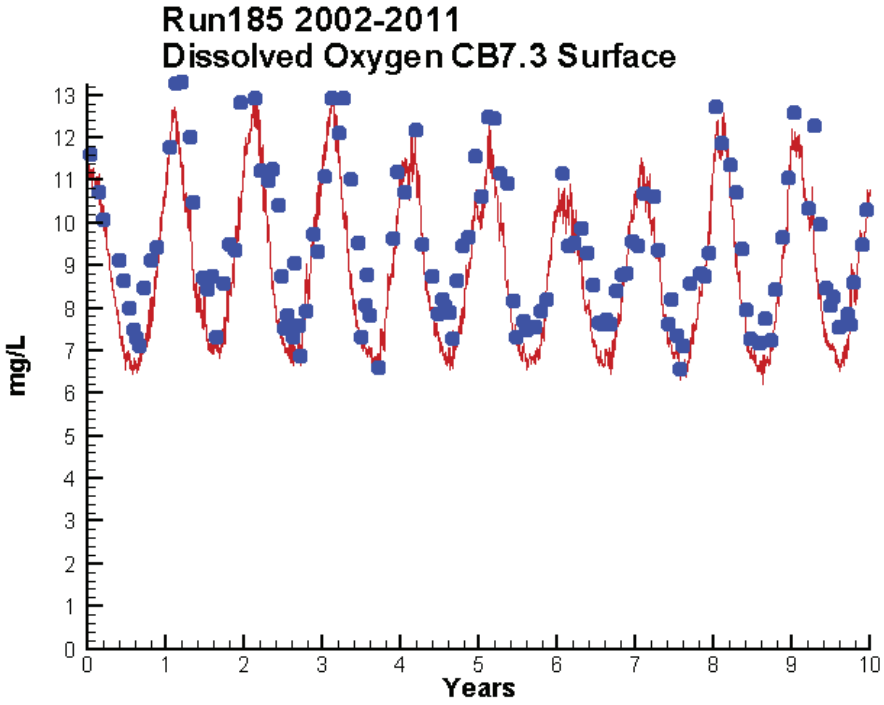


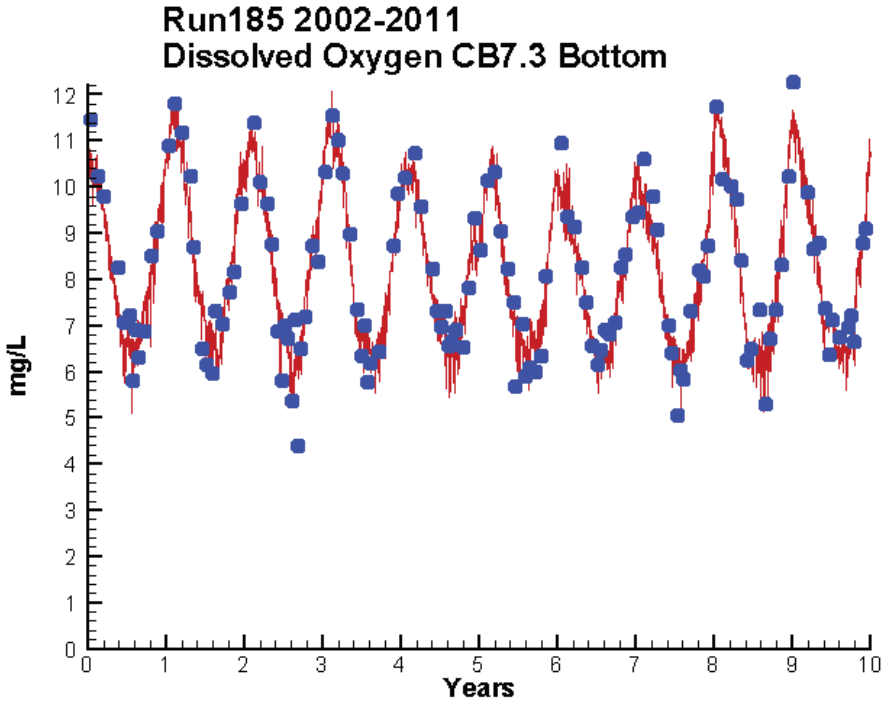


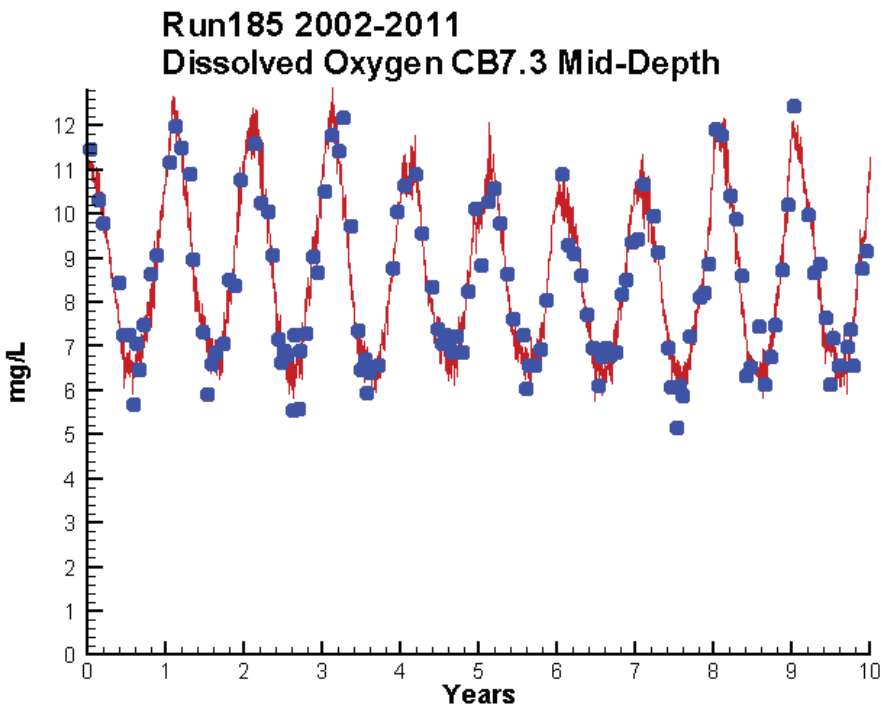


	Mean Difference	Absolute Mean Difference
Chl	1.3534	2.8901
DIN	-0.0171	0.0298
KE	0.0516	0.2314
DIP	0.0050	0.0052
TP	0.0077	0.0088
TN	0.1238	0.1246

Station CB7.3

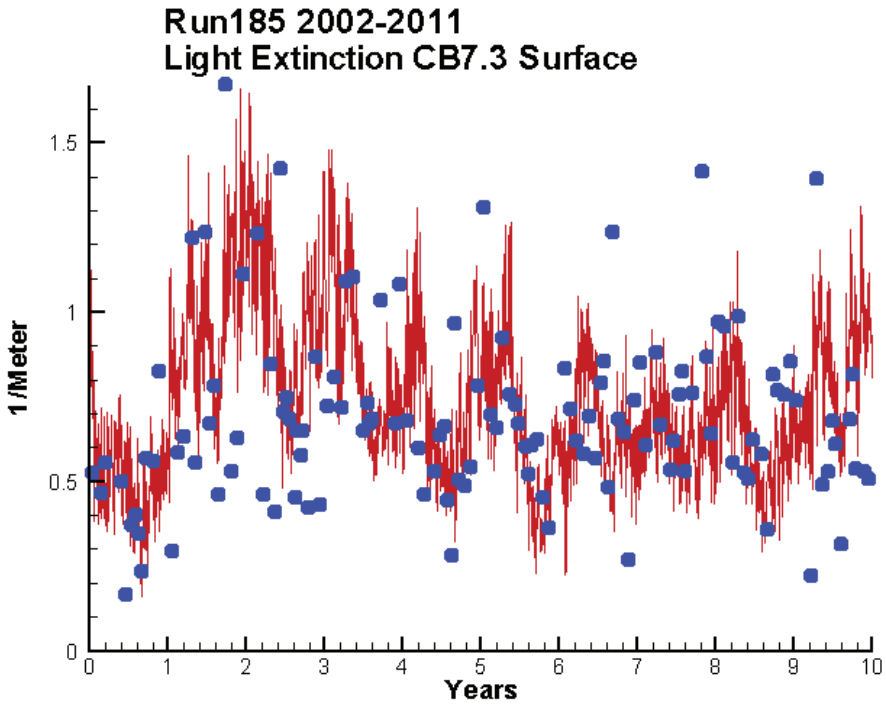


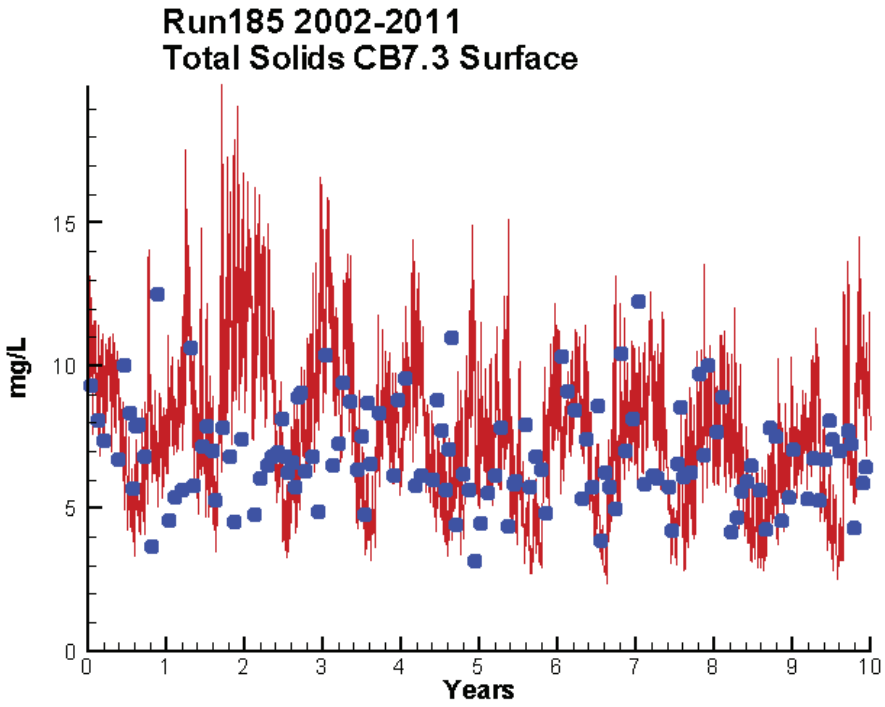


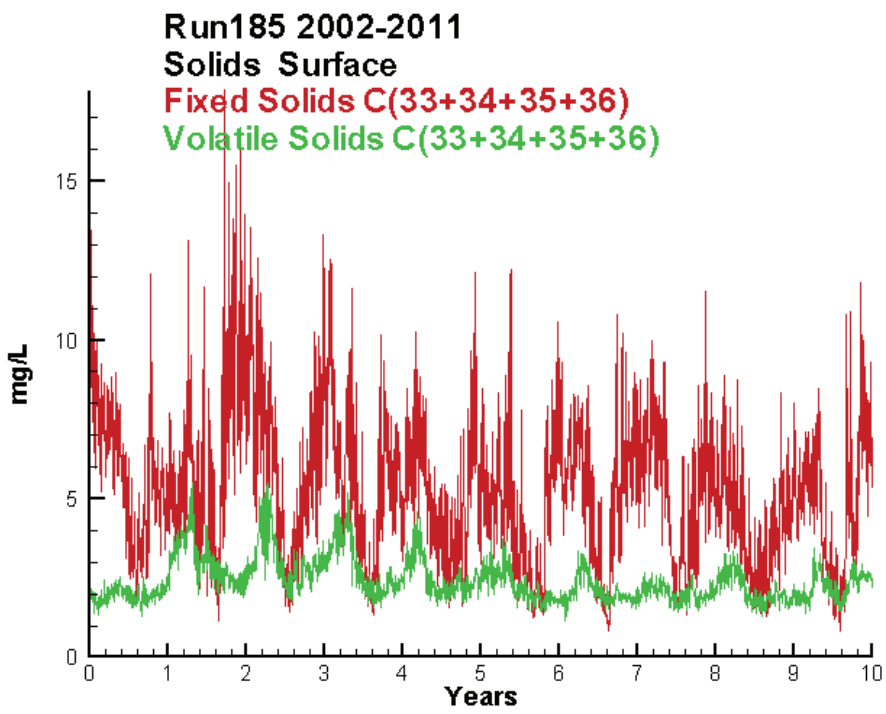


	Mean Difference	Absolute Mean Difference
Top DO	-0.7073	0.8732
Mid DO	0.0301	0.4848
Bot DO	-0.0539	0.5967

Station CB7.3

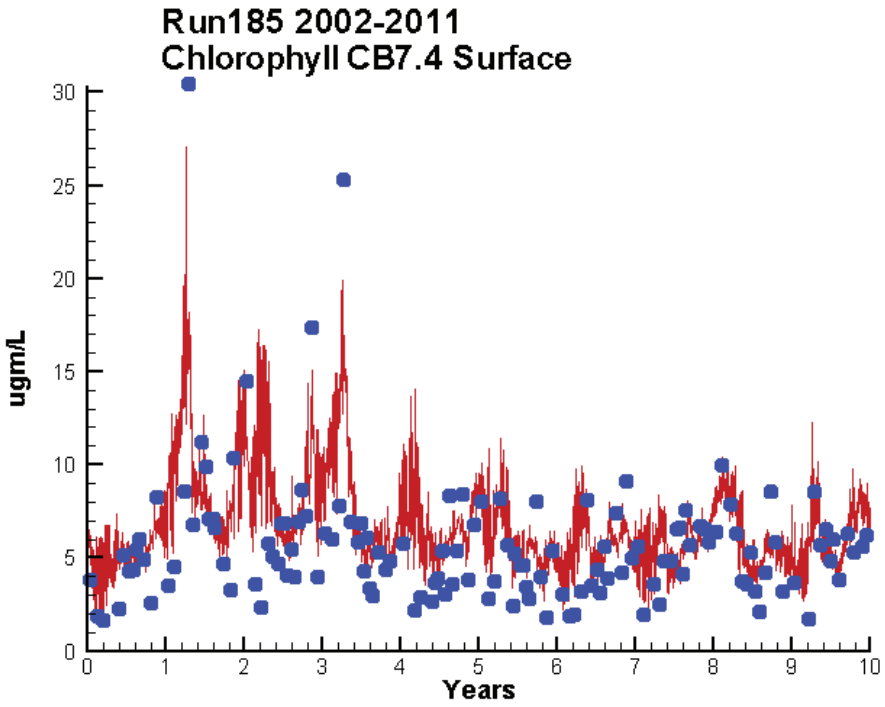


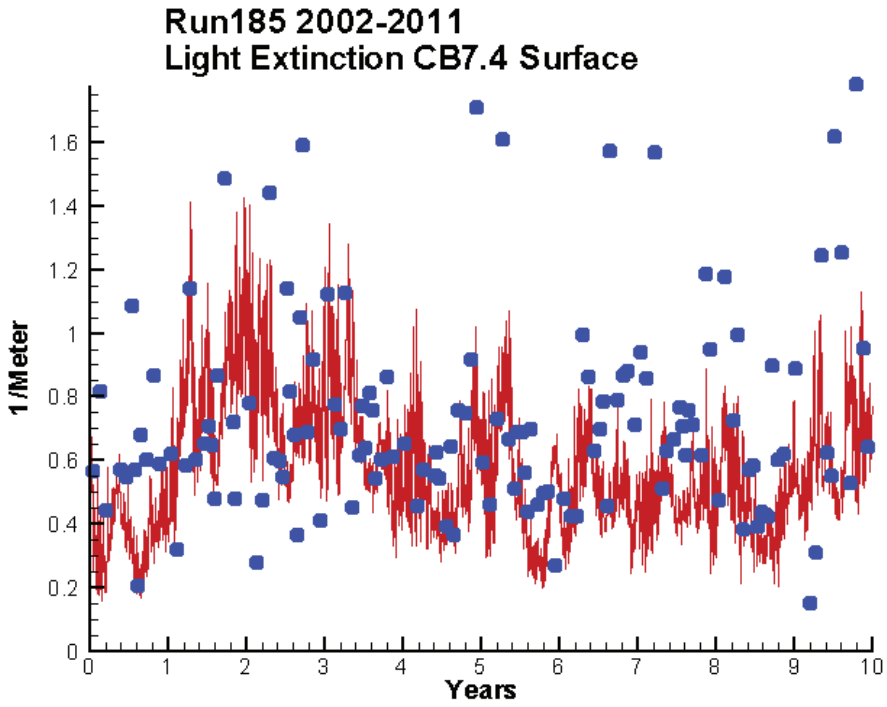


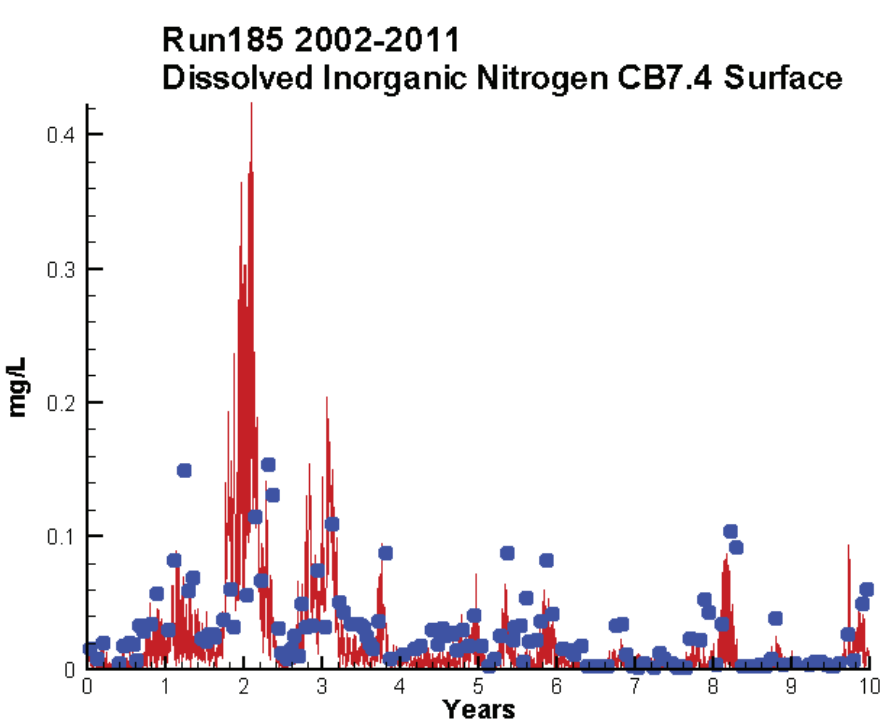


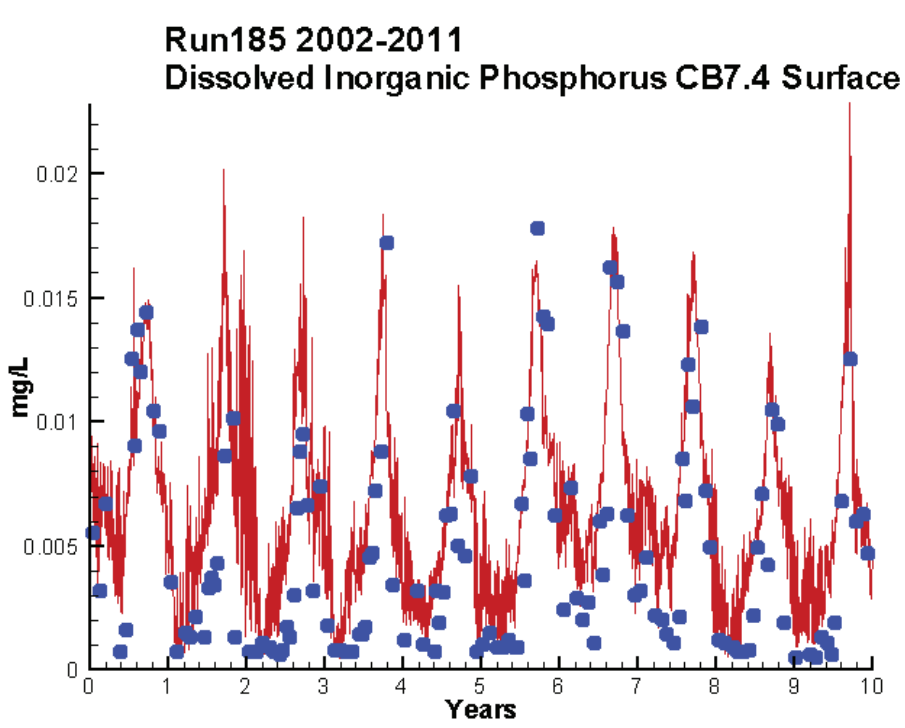
	Mean Difference	Absolute Mean Difference
KE	0.0516	0.2314
TSS	0.1581	2.1830

Station CB7.4

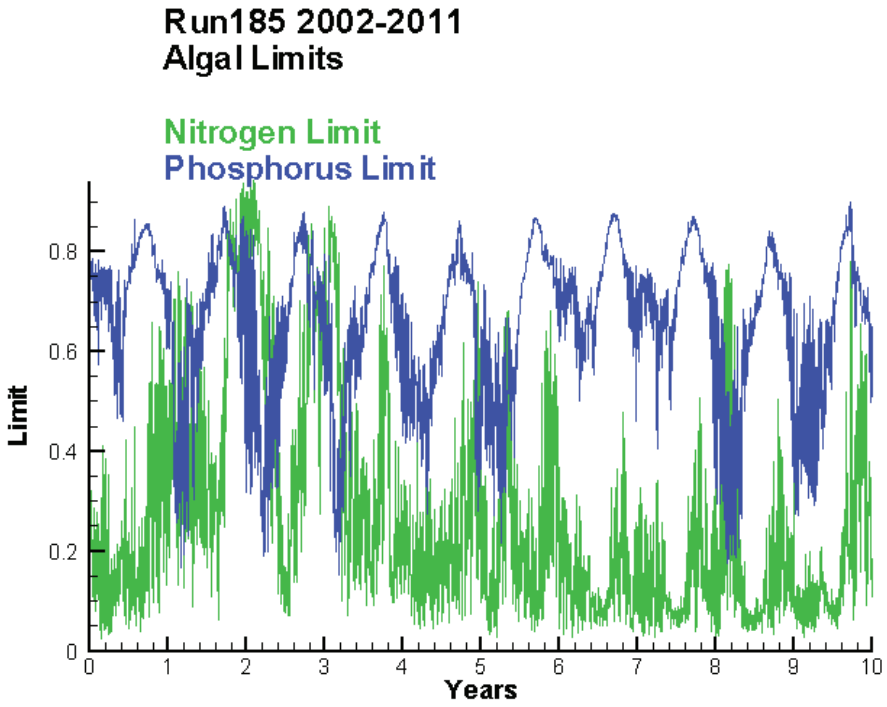


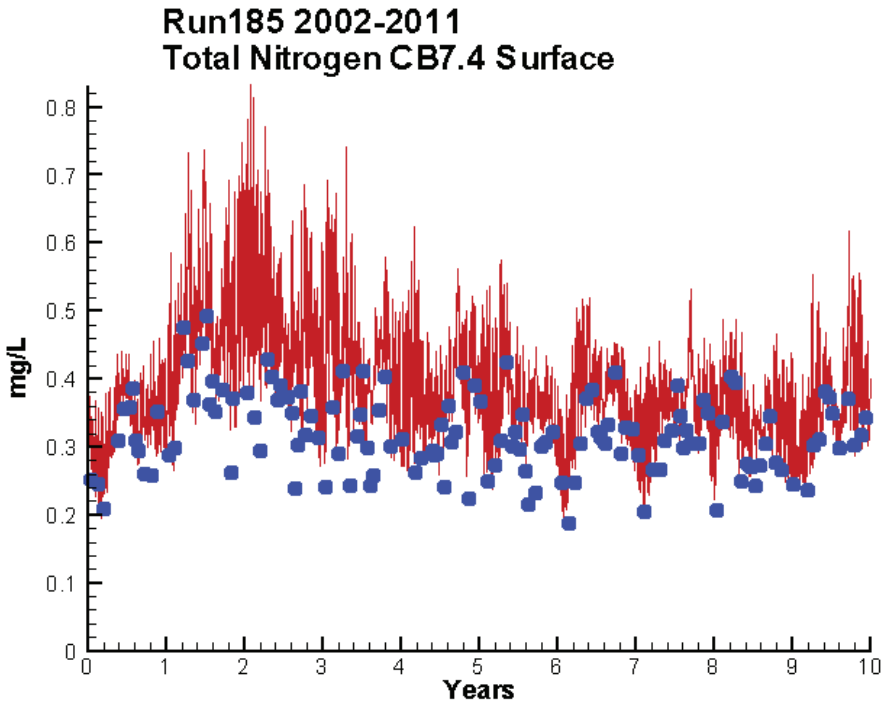


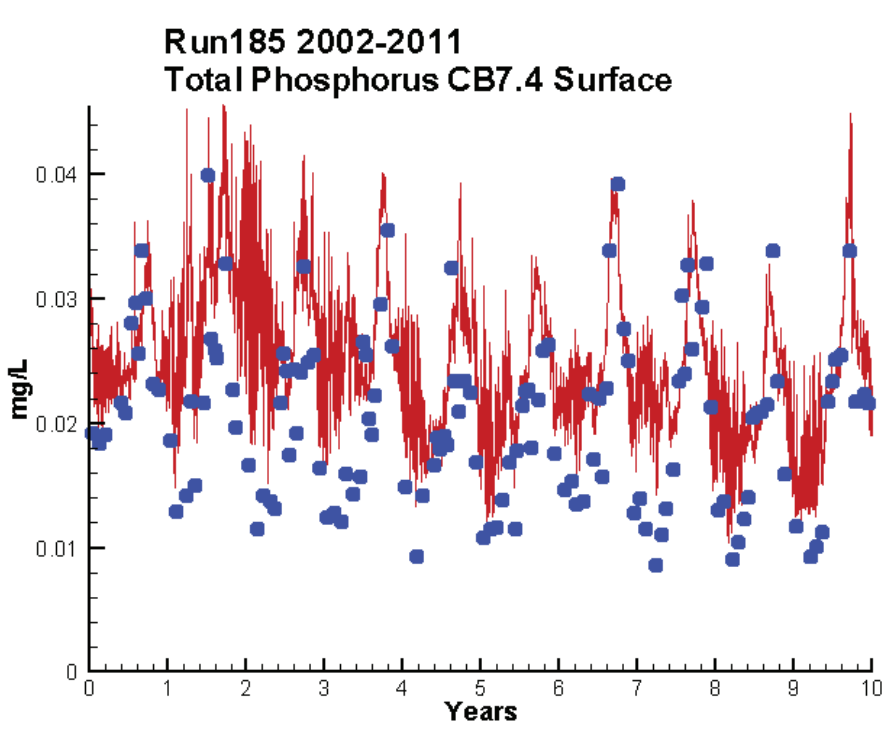




Station CB7.4

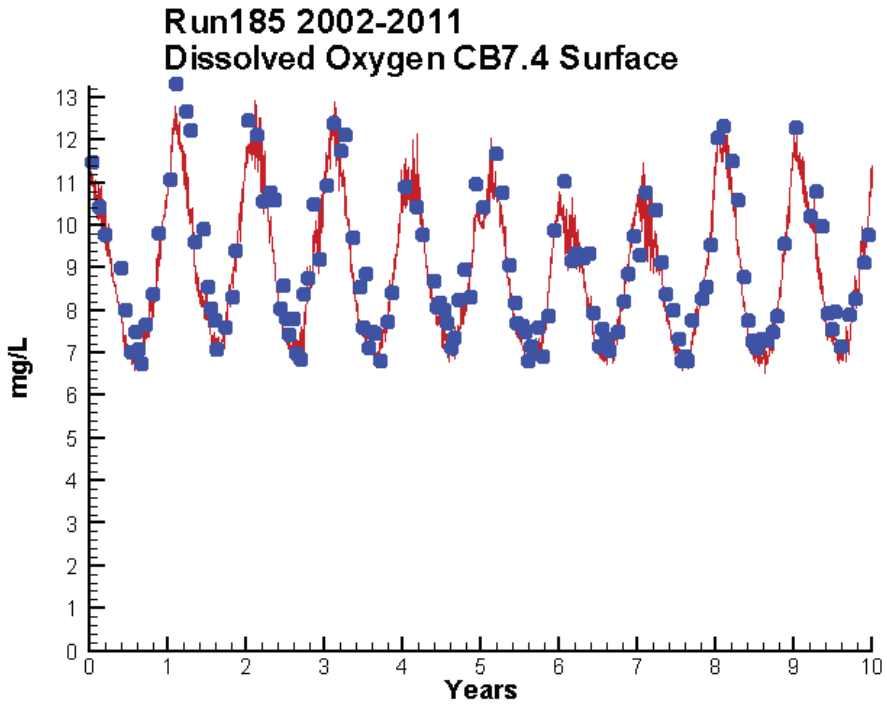


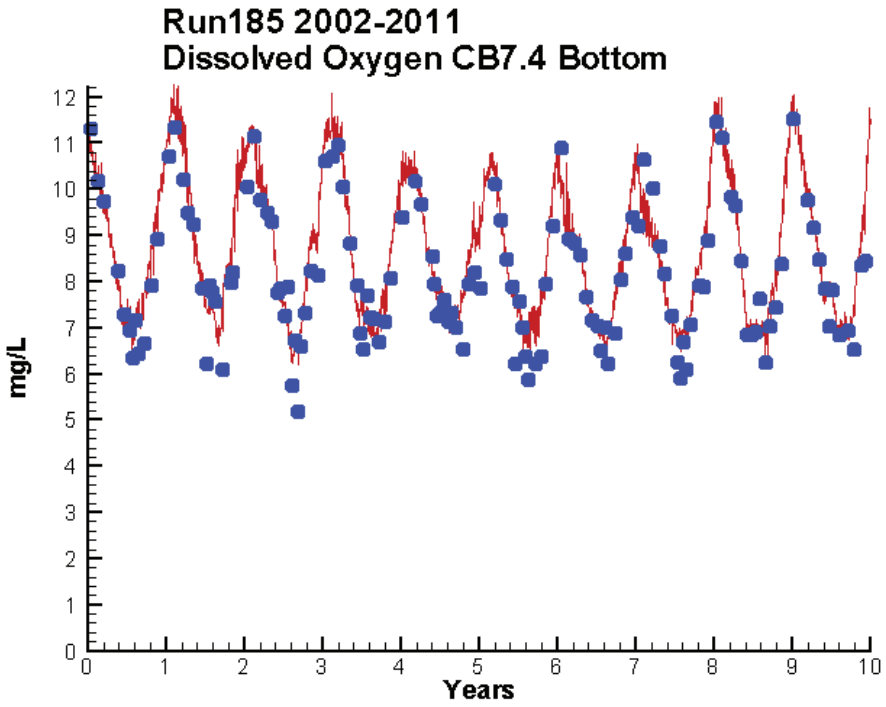


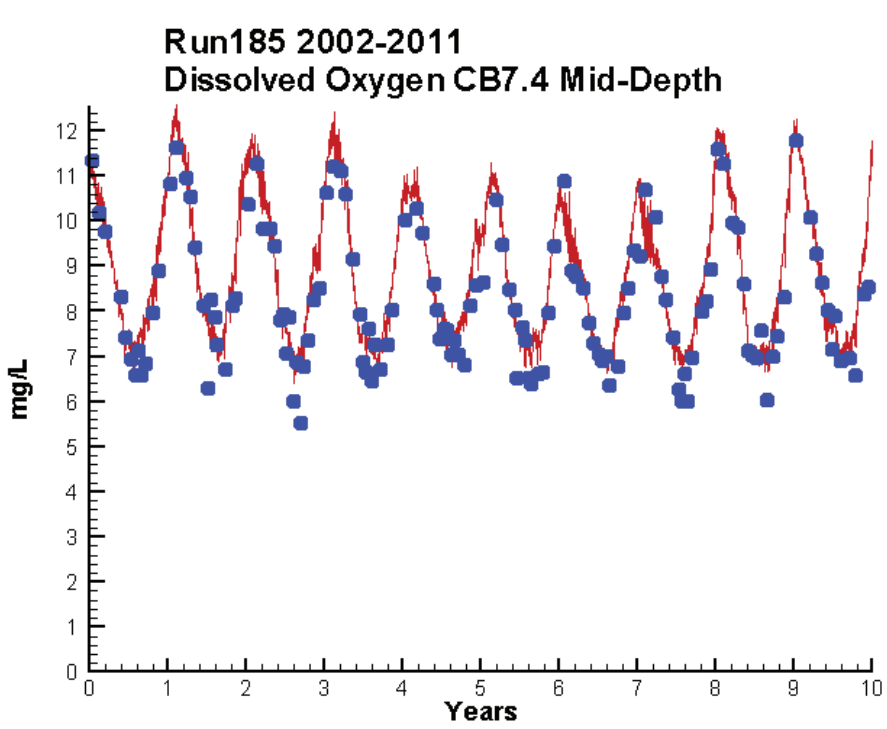


	Mean Difference	Absolute Mean Difference
Chl	0.9973	2.1659
DIN	-0.0127	0.0196
KE	-0.1623	0.2717
DIP	0.0023	0.0030
TP	0.0053	0.0063
TN	0.0821	0.0882

Station CB7.4

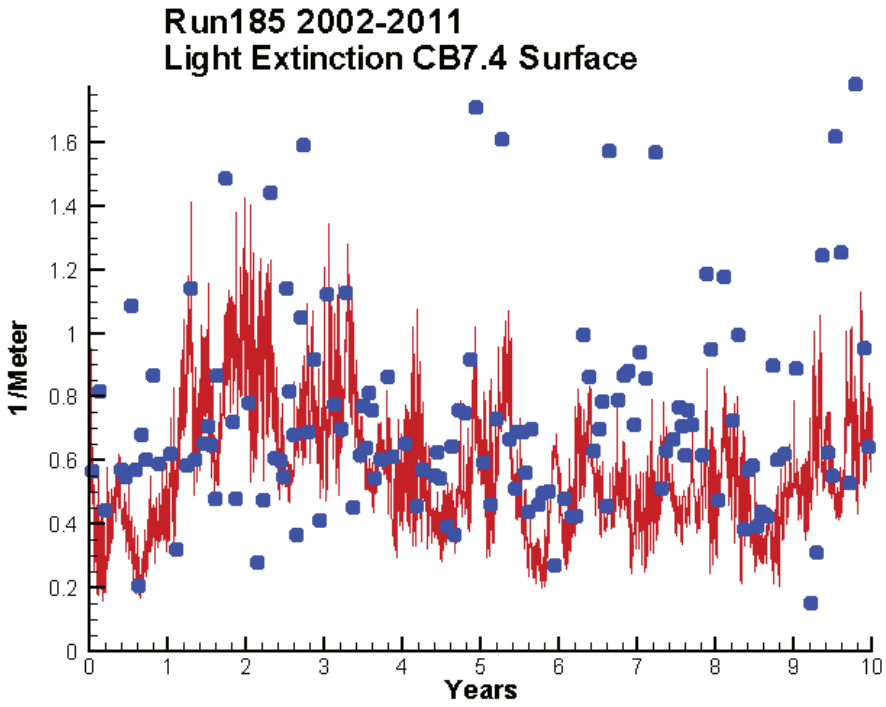


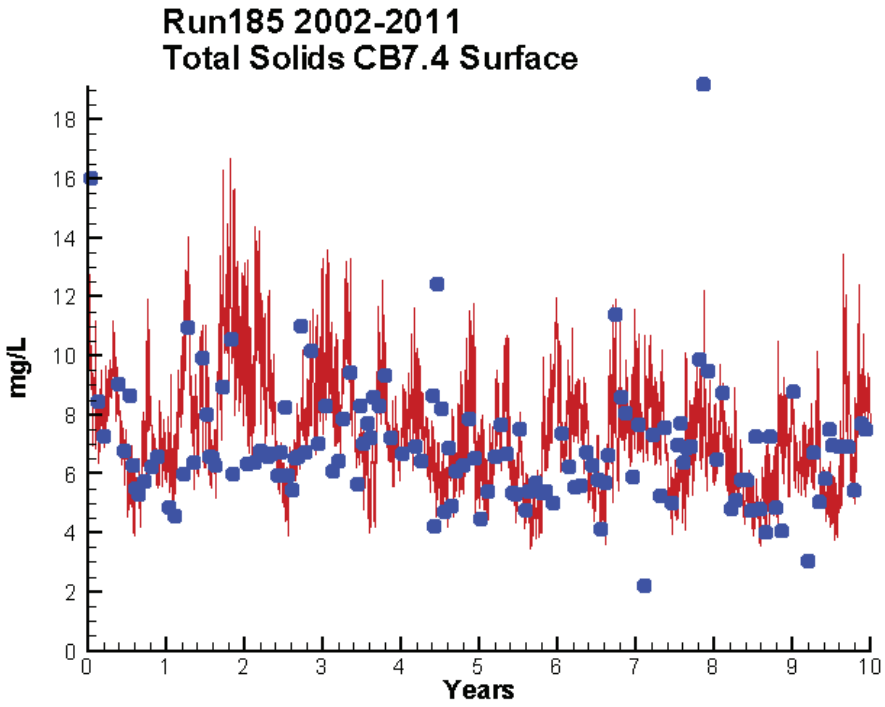


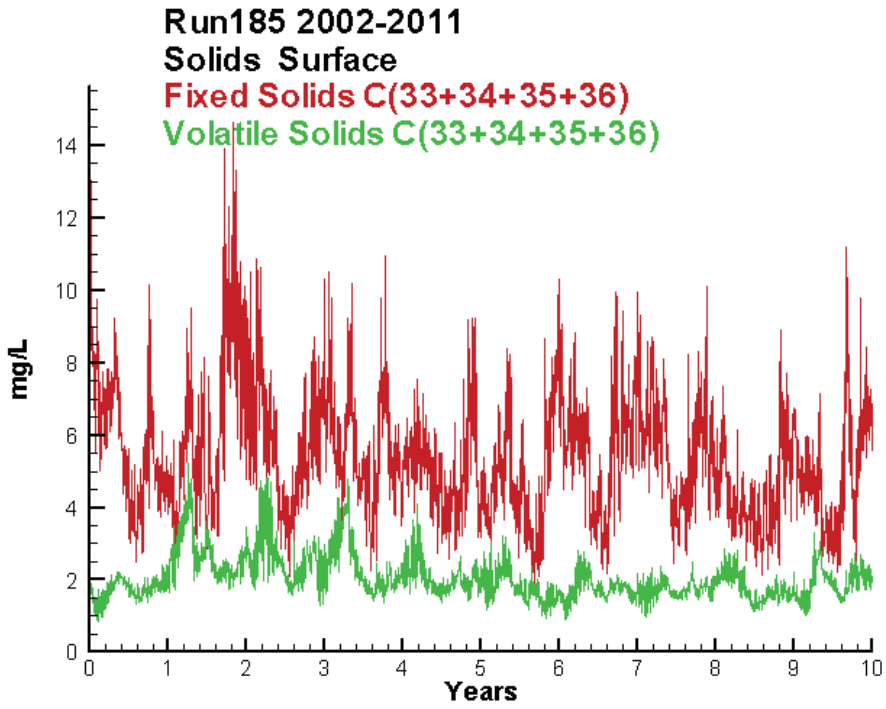


	Mean Difference	Absolute Mean Difference
Top DO	-0.3434	0.5583
Mid DO	0.3431	0.5555
Bot DO	0.3323	0.5434

Station CB7.4

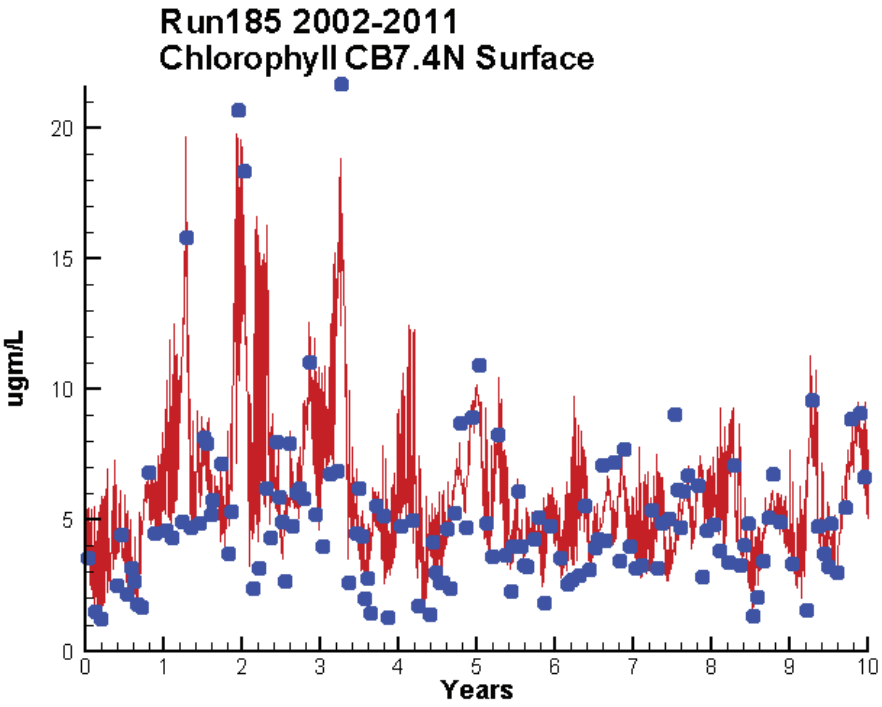


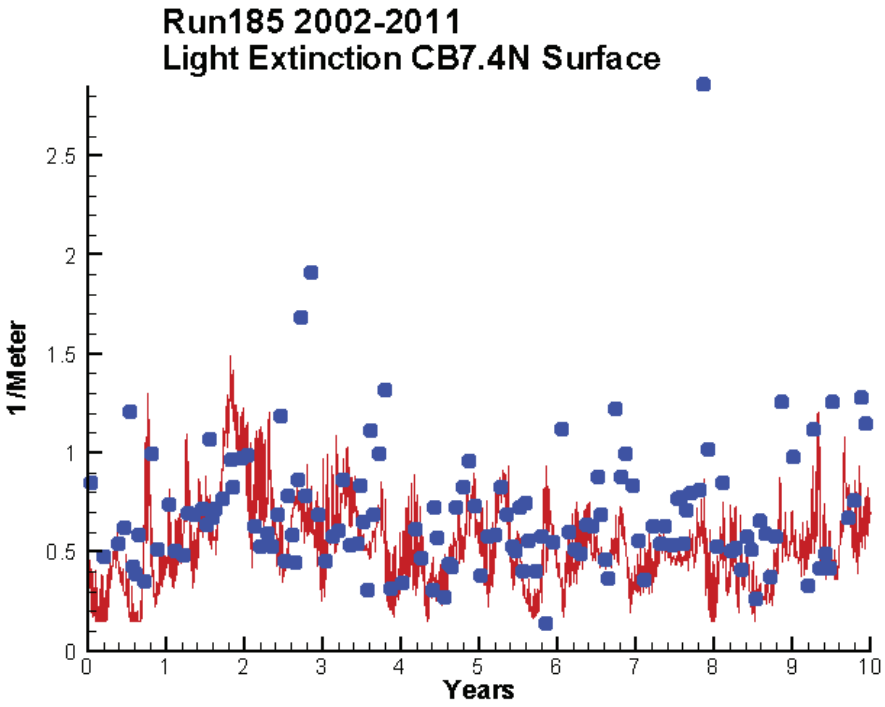


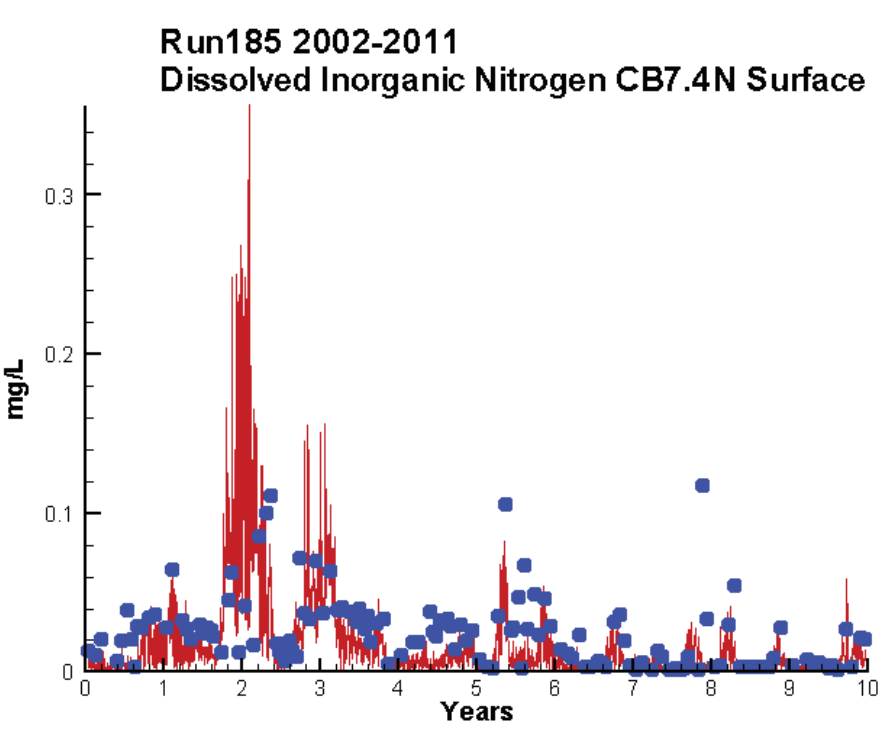


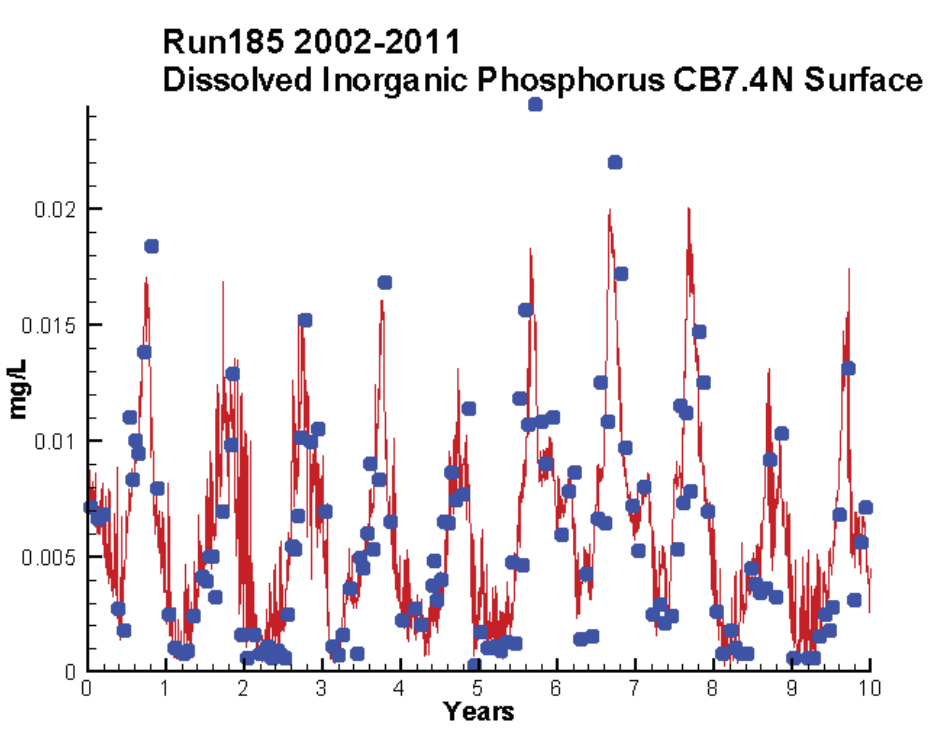
	Mean Difference	Absolute Mean Difference
KE	-0.1623	0.2717
TSS	0.2137	1.5324

Station CB7.4N

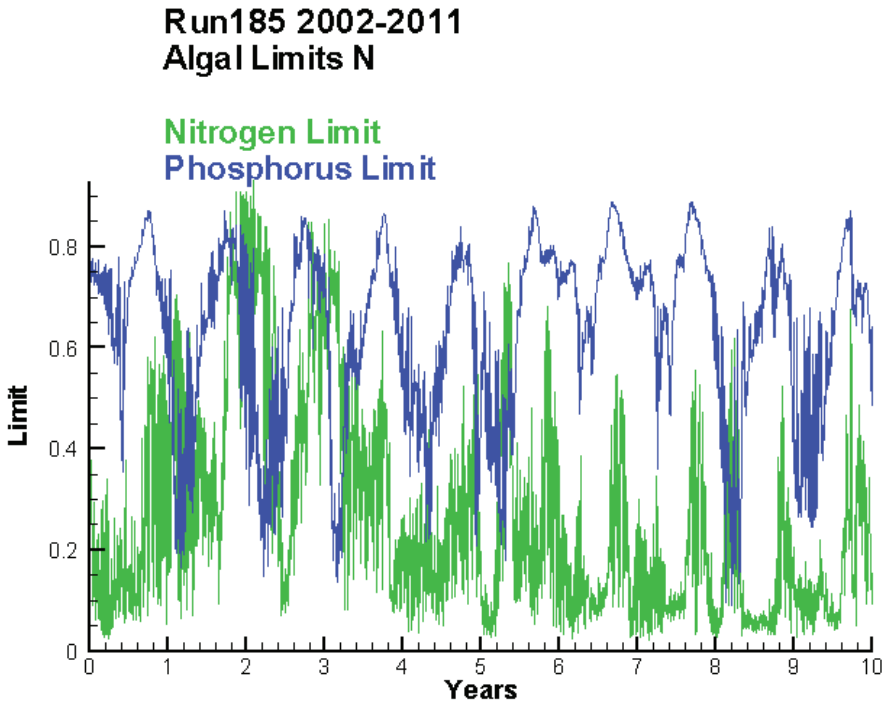


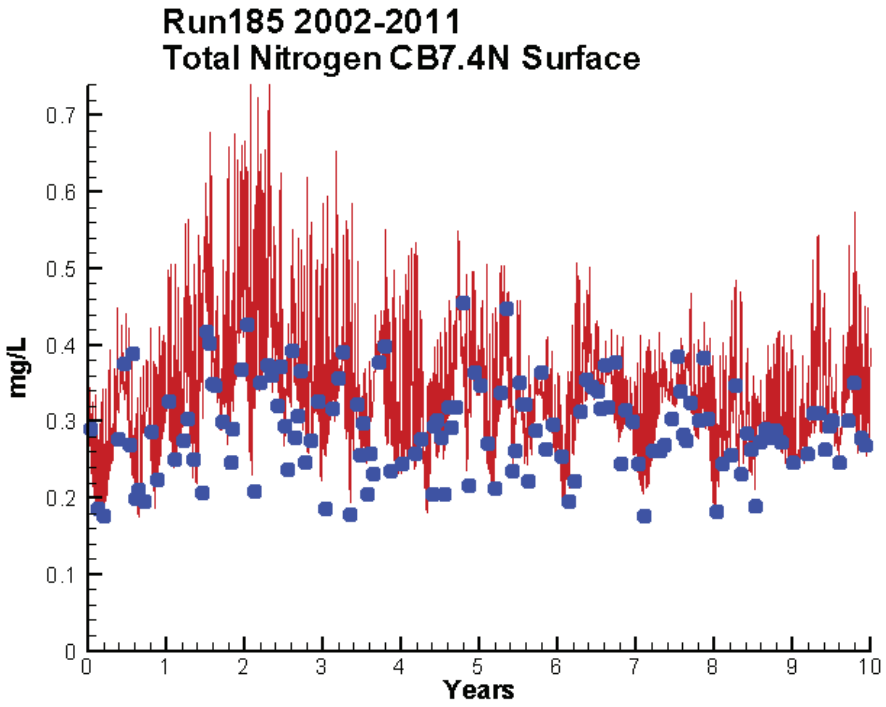


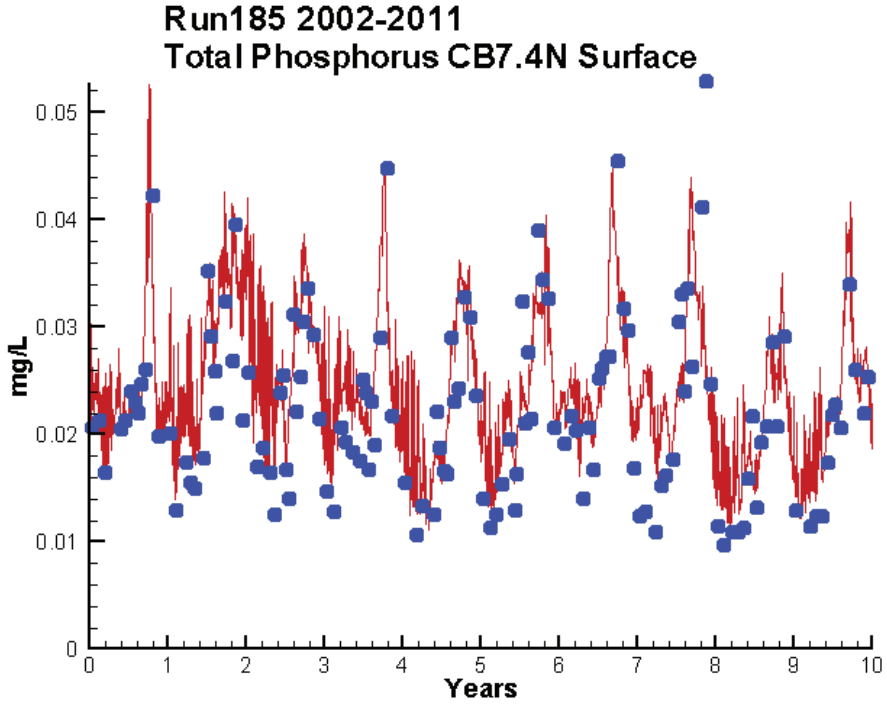




Station CB7.4N

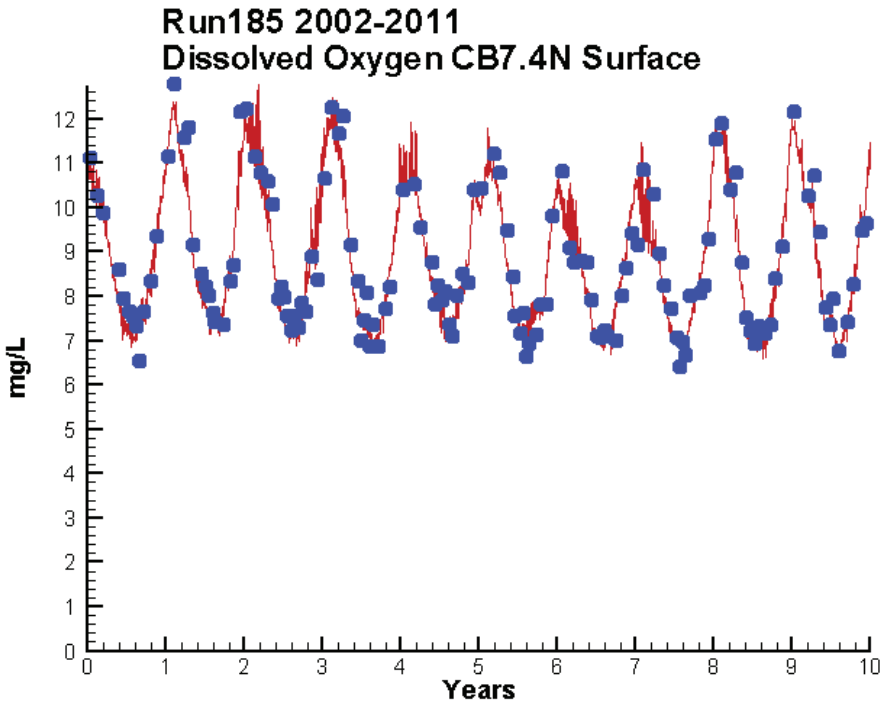


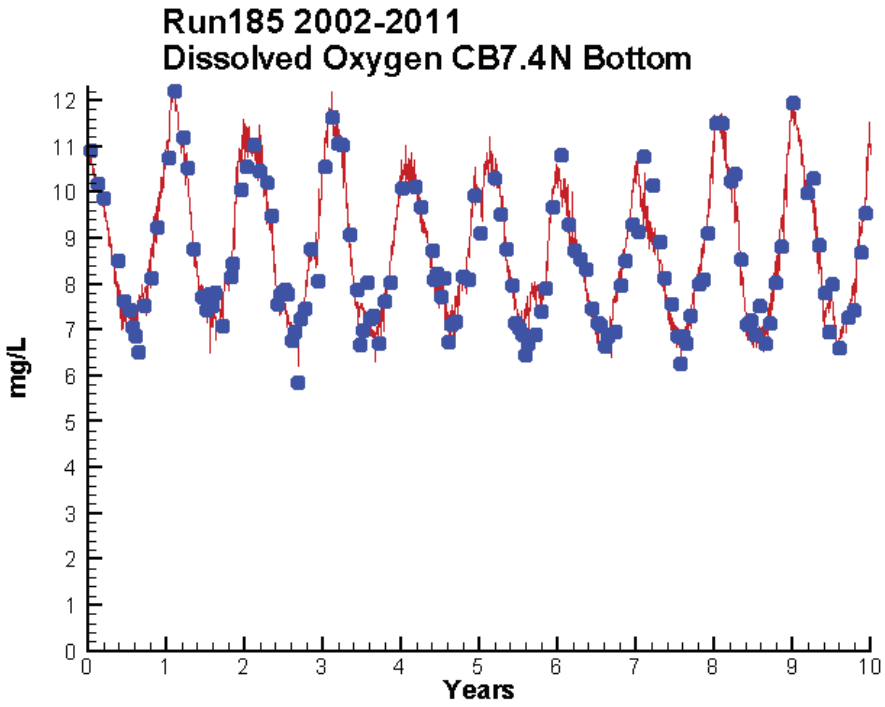


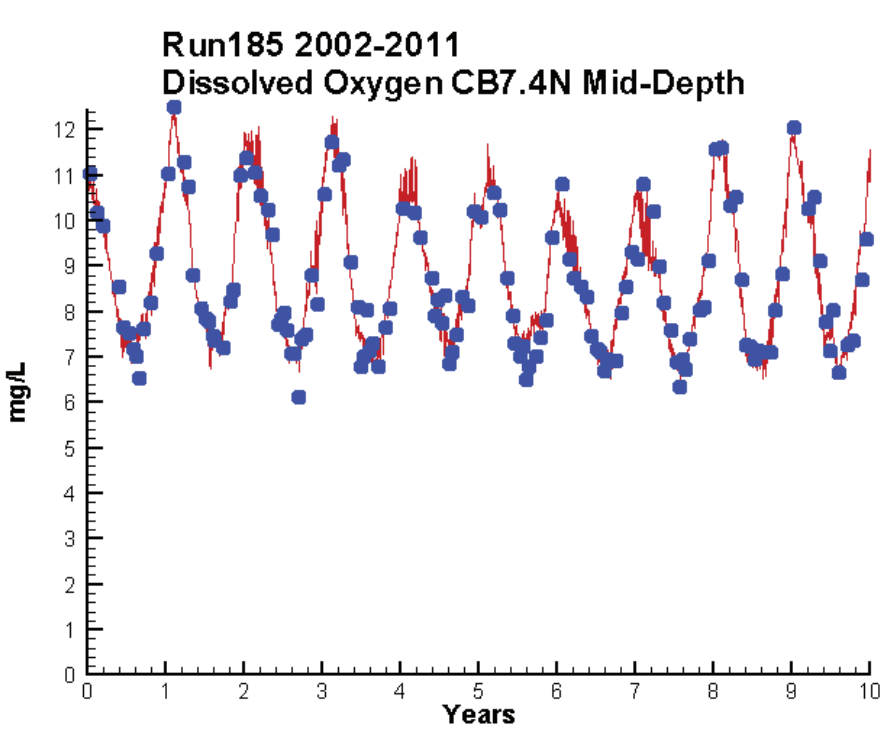


	Mean Difference	Absolute Mean Difference
Chl	0.8250	1.8256
DIN	-0.0084	0.0157
KE	-0.1608	0.2704
DIP	0.0007	0.0025
TP	0.0028	0.0051
TN	0.0579	0.0724

Station CB7.4N

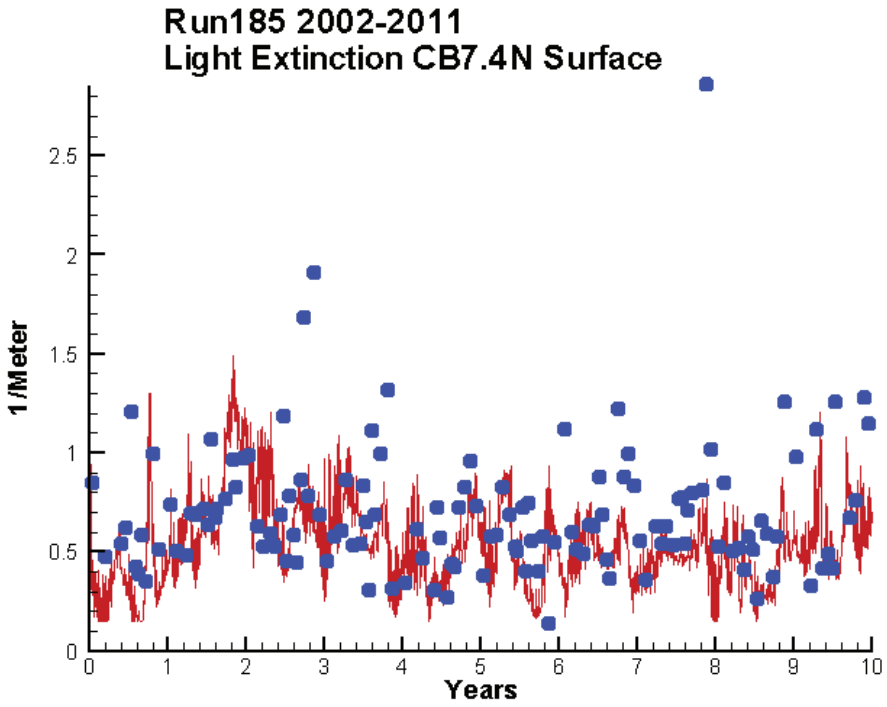


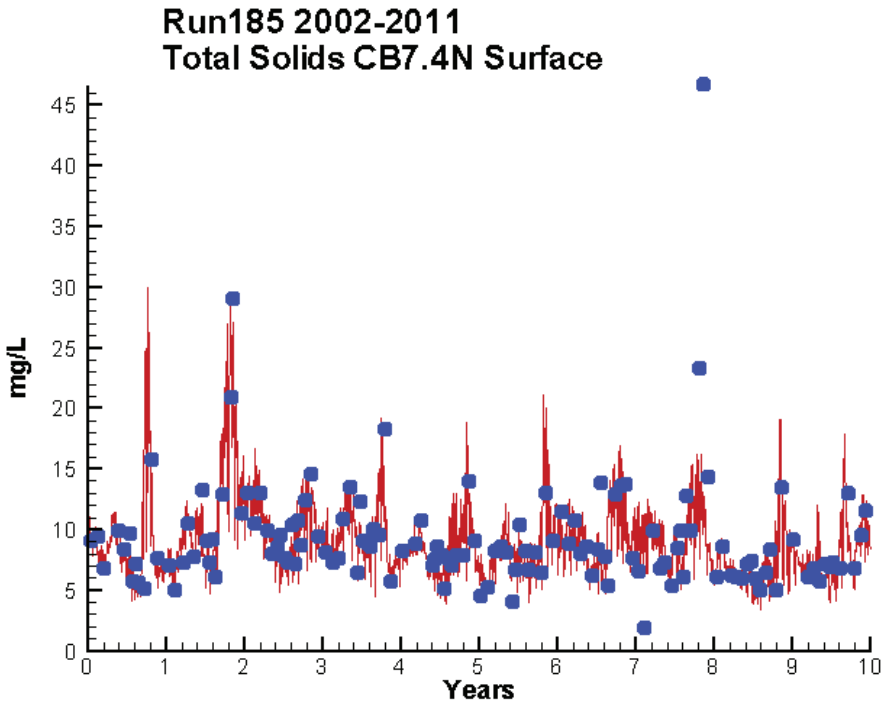


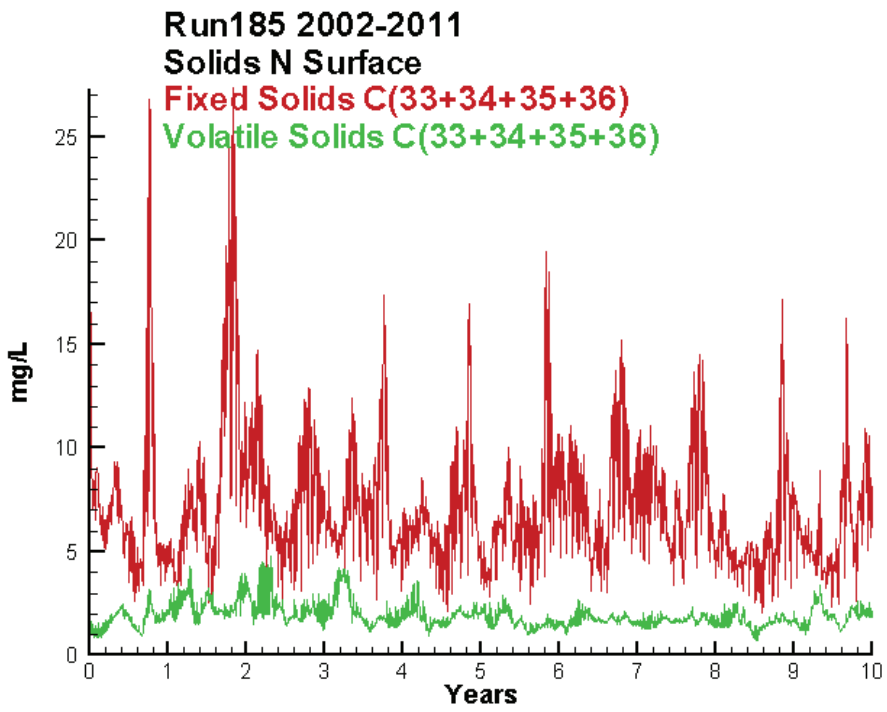


	Mean Difference	Absolute Mean Difference
Top DO	-0.1361	0.4442
Mid DO	0.0669	0.4116
Bot DO	0.0815	0.4185

Station CB7.4N



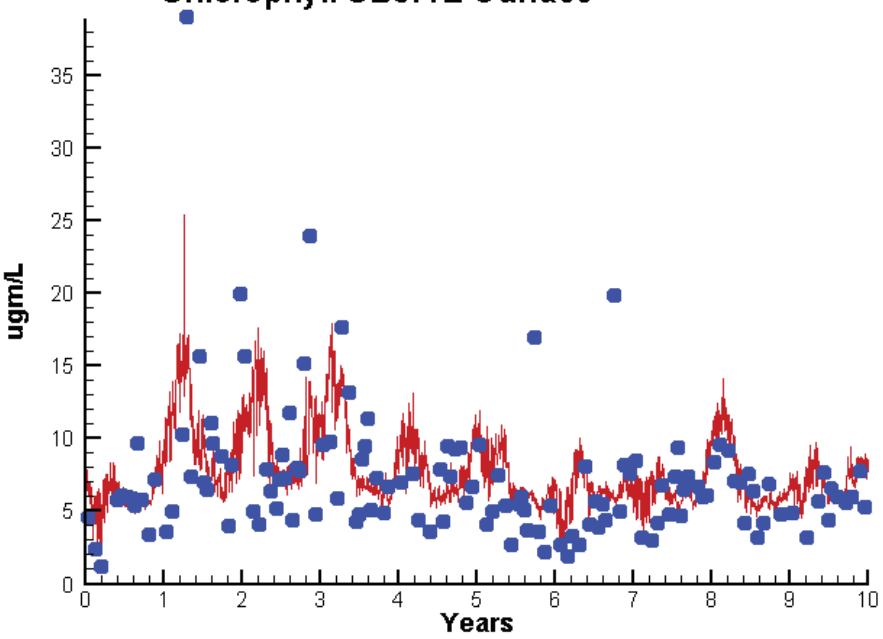




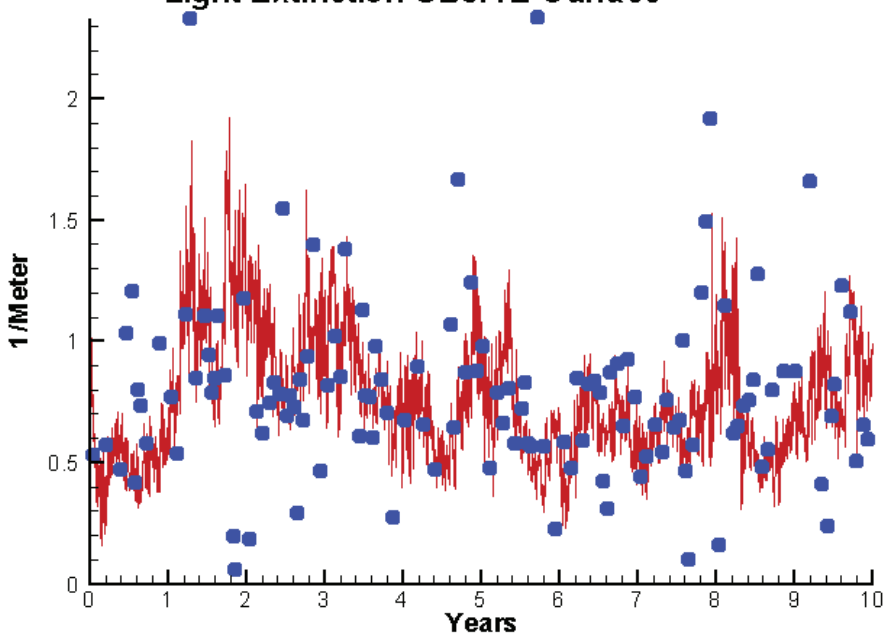
	Mean Difference	Absolute Mean Difference
KE	-0.1608	0.2704
TSS	-0.3713	2.2356

Station CB8.1E

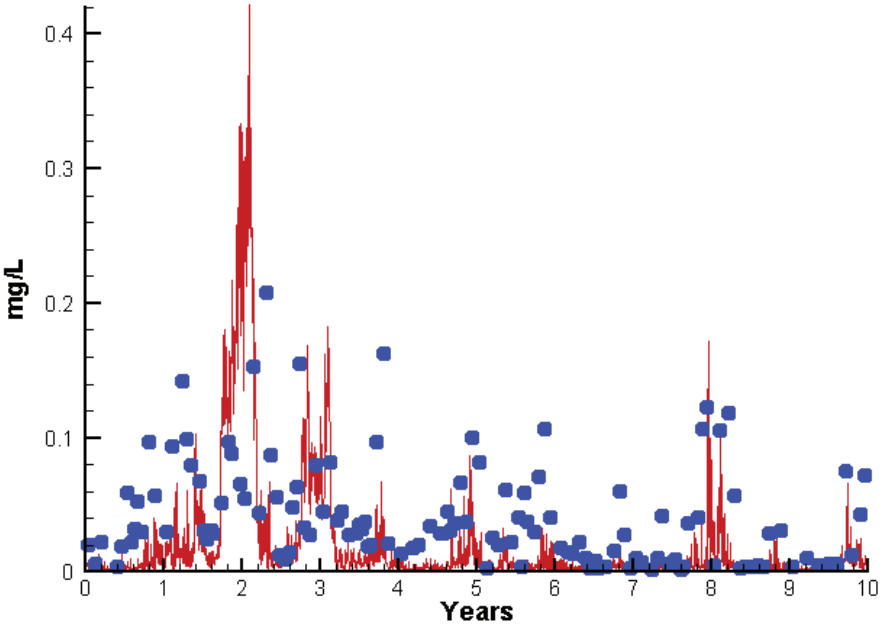
Run185 2002-2011
Chlorophyll CB8.1E Surface



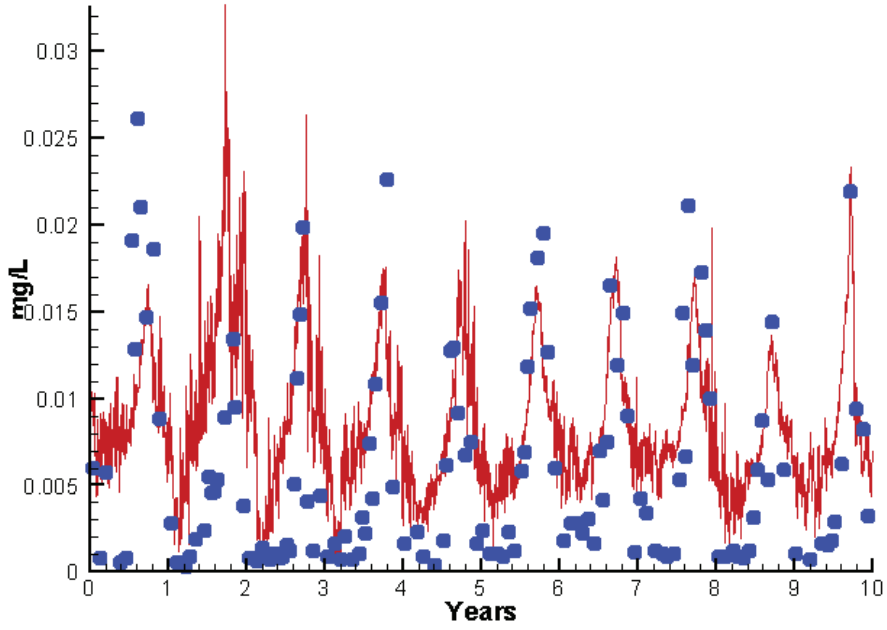
Run185 2002-2011
Light Extinction CB8.1E Surface



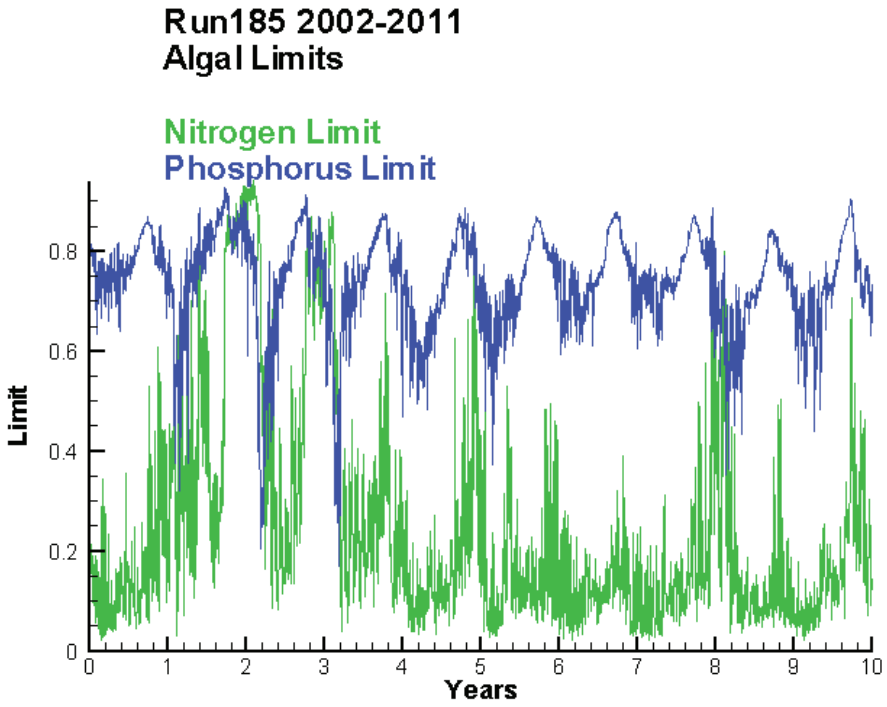
Run185 2002-2011
Dissolved Inorganic Nitrogen CB8.1E Surface

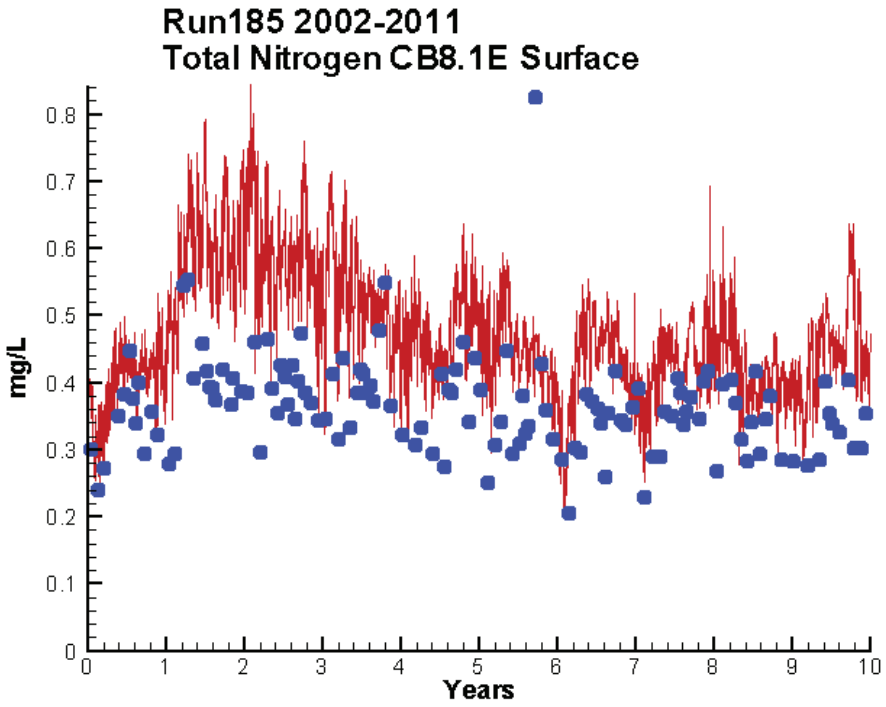


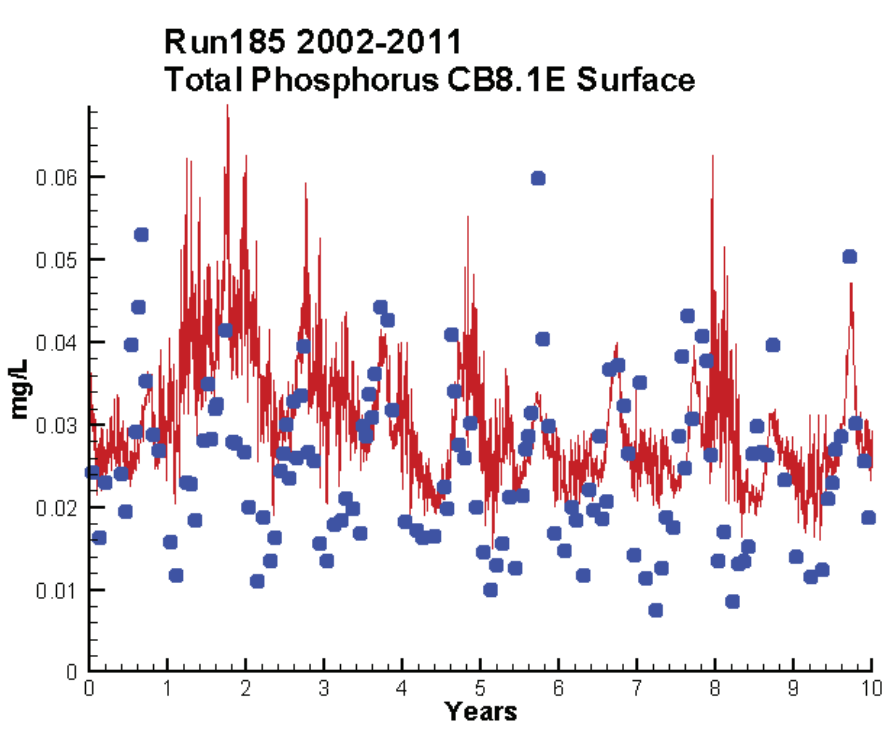
Run185 2002-2011
Dissolved Inorganic Phosphorus CB8.1E Surface



Station CB8.1E

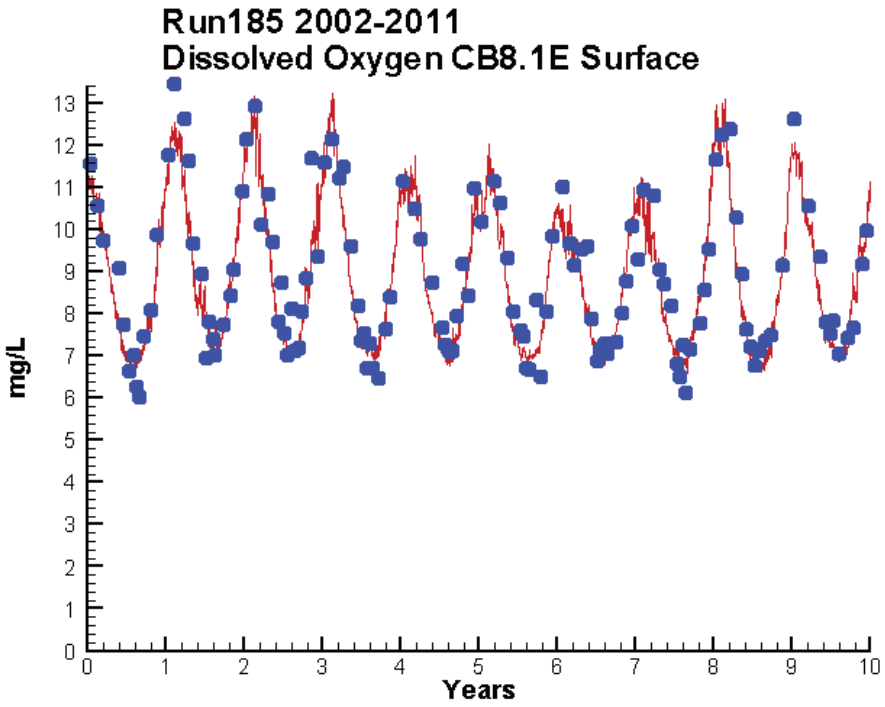


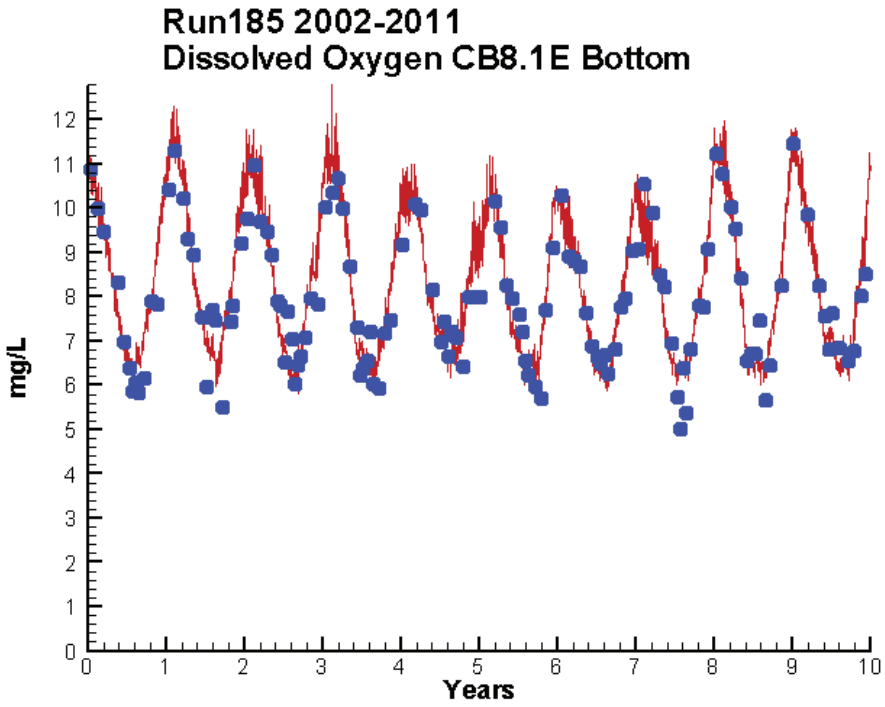


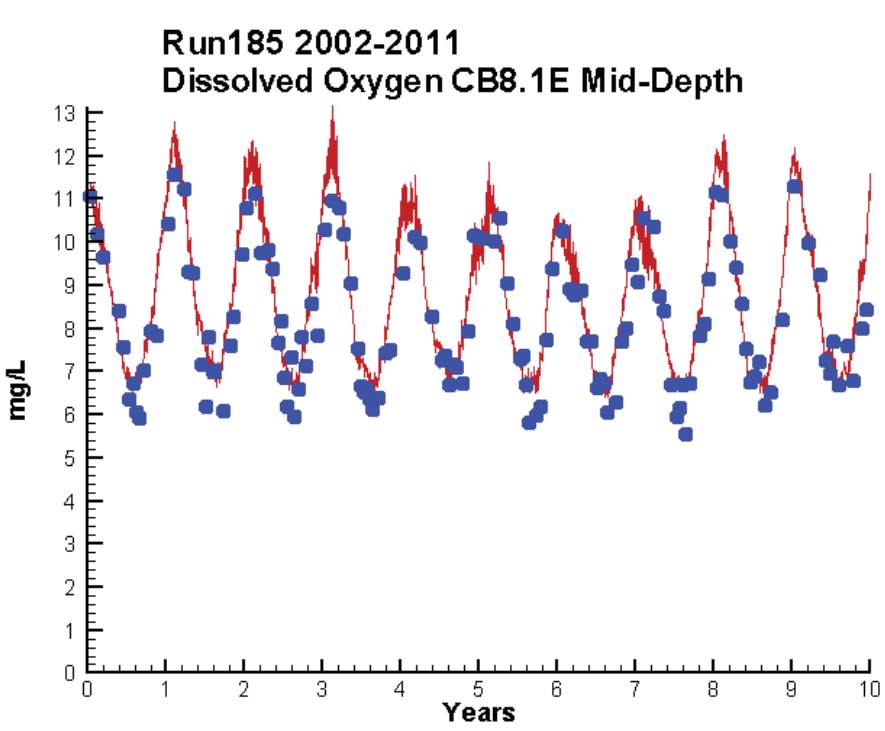


	Mean Difference	Absolute Mean Difference
Chl	0.6193	2.8288
DIN	-0.0222	0.0328
KE	0.0113	0.3029
DIP	0.0029	0.0047
TP	0.0056	0.0097
TN	0.1225	0.1302

Station CB8.1E

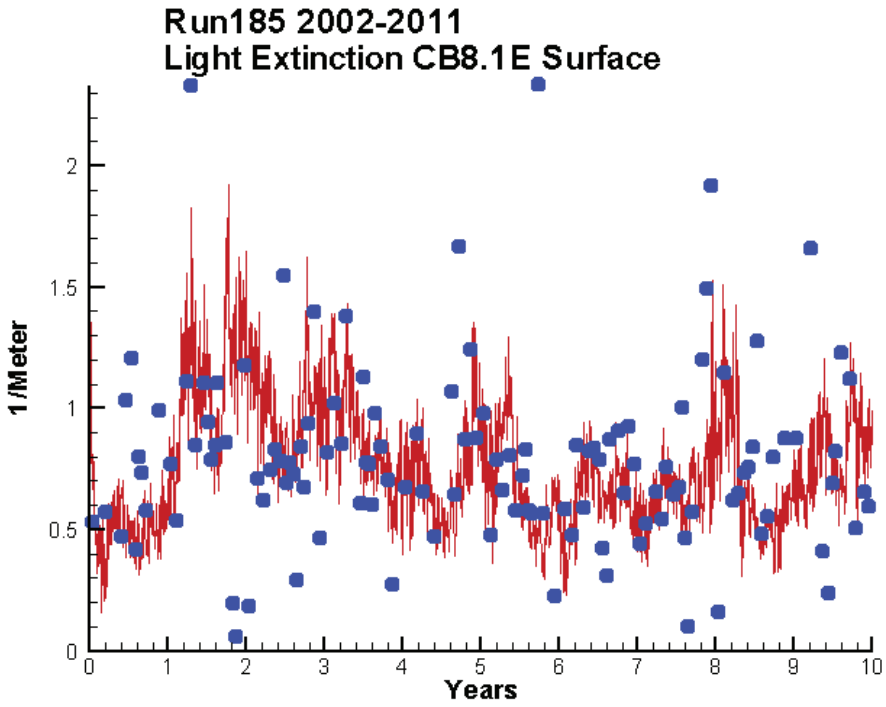


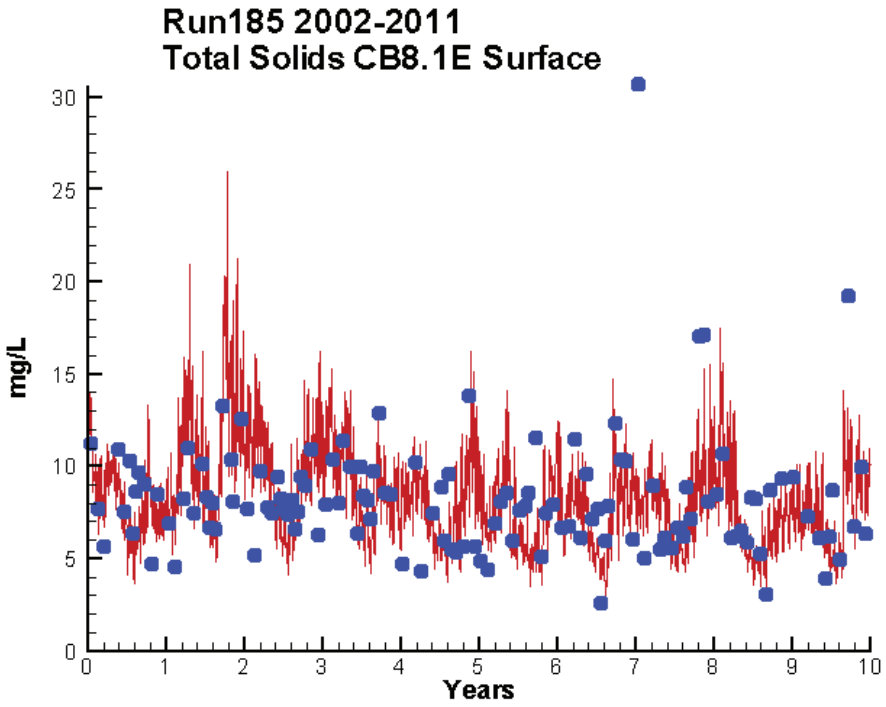


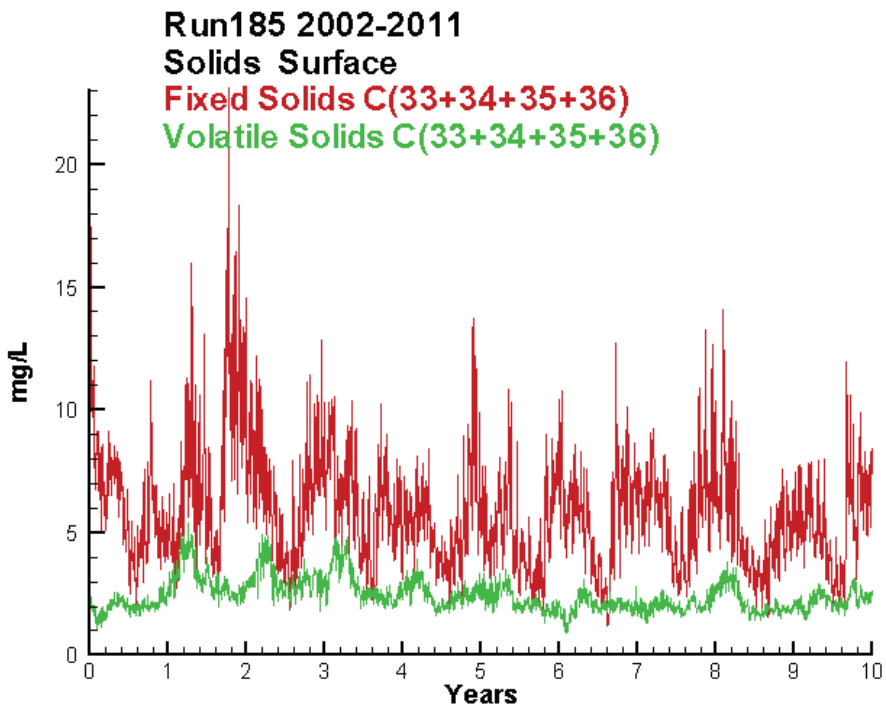


	Mean Difference	Absolute Mean Difference
Top DO	-0.1804	0.5446
Mid DO	0.3843	0.6097
Bot DO	0.1285	0.5727

Station CB8.1E

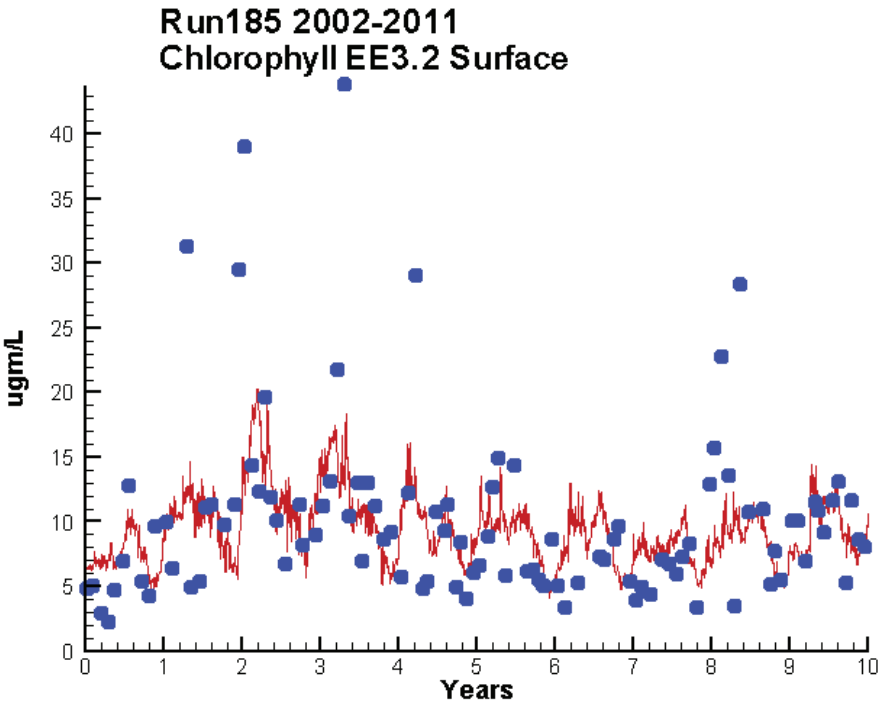


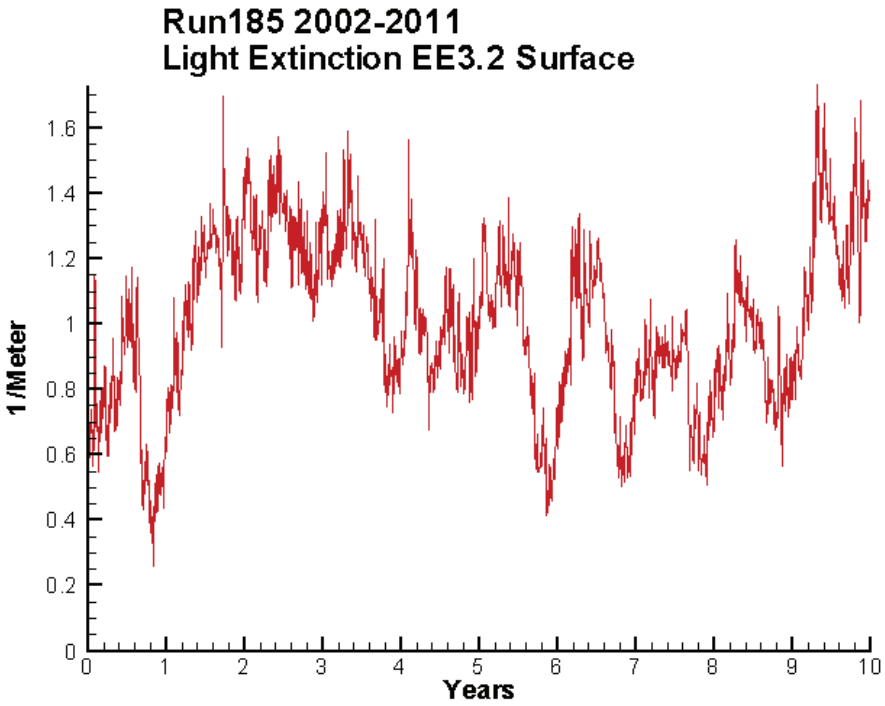


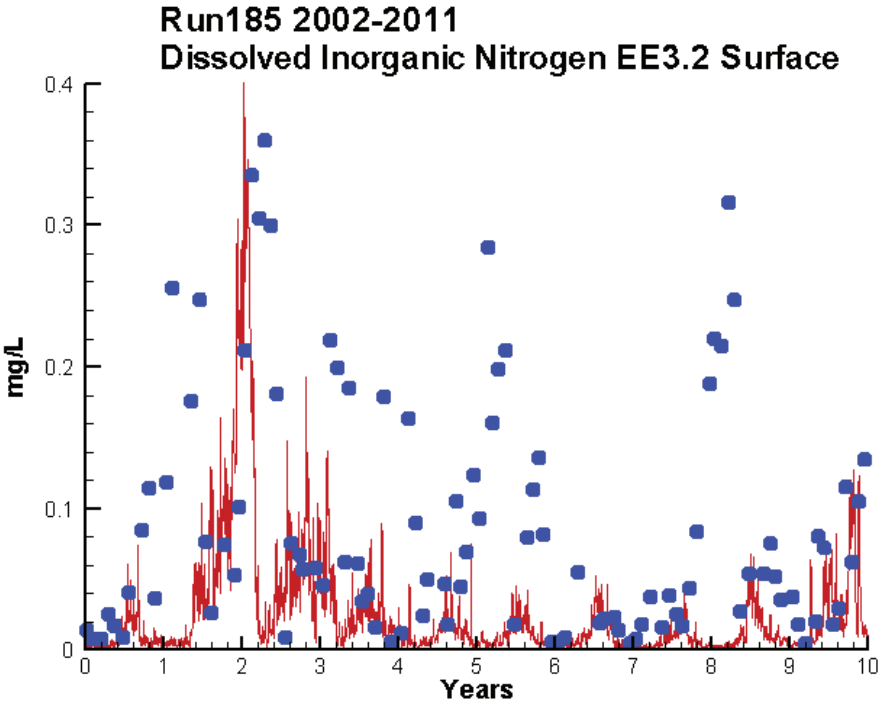


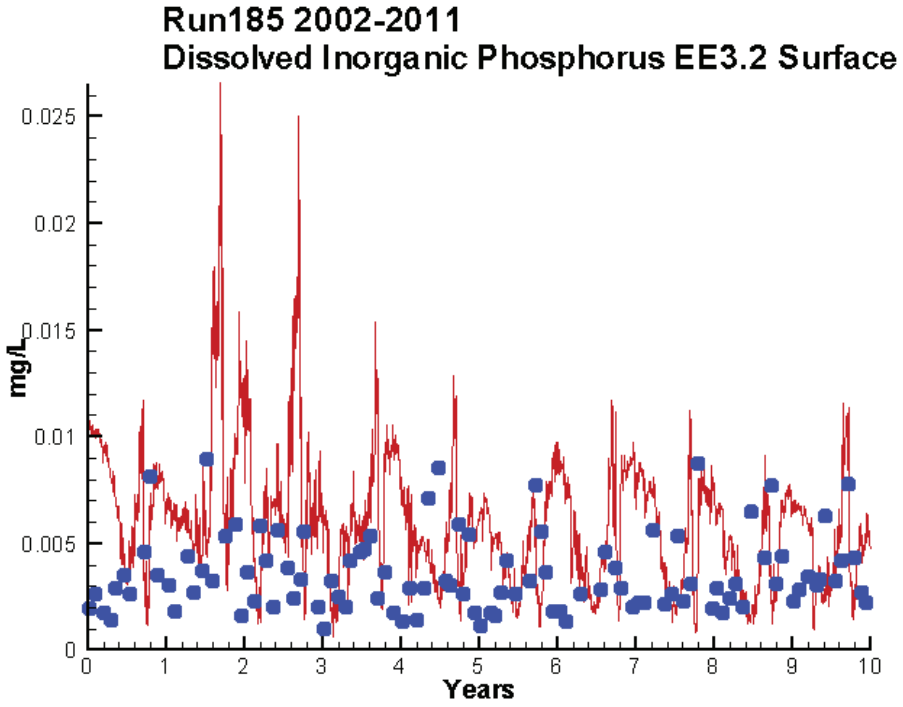
	Mean Difference	Absolute Mean Difference
KE	0.0113	0.3029
TSS	-0.2186	2.3518

Station EE3.2

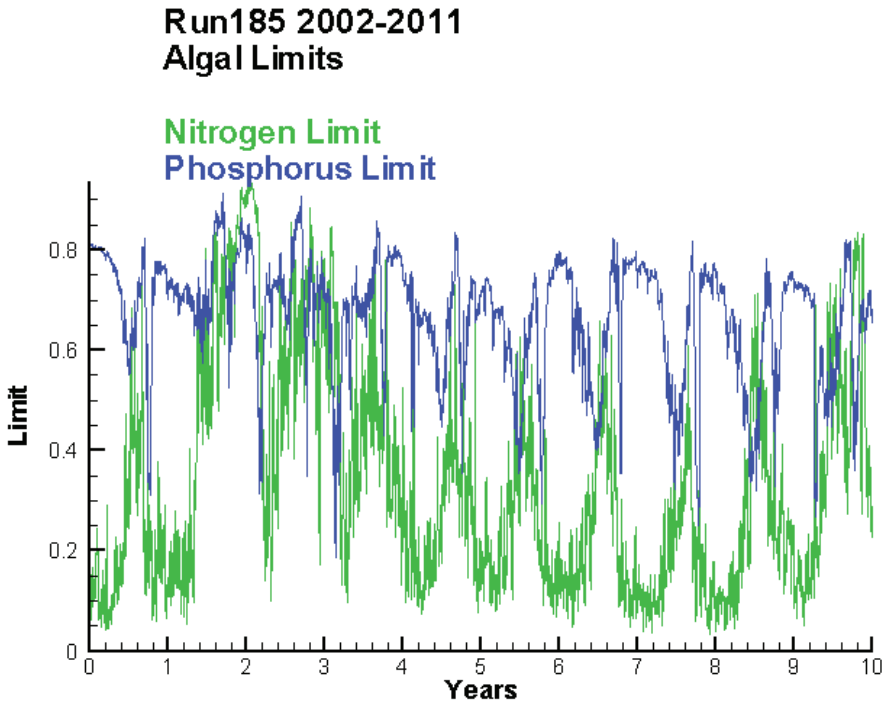


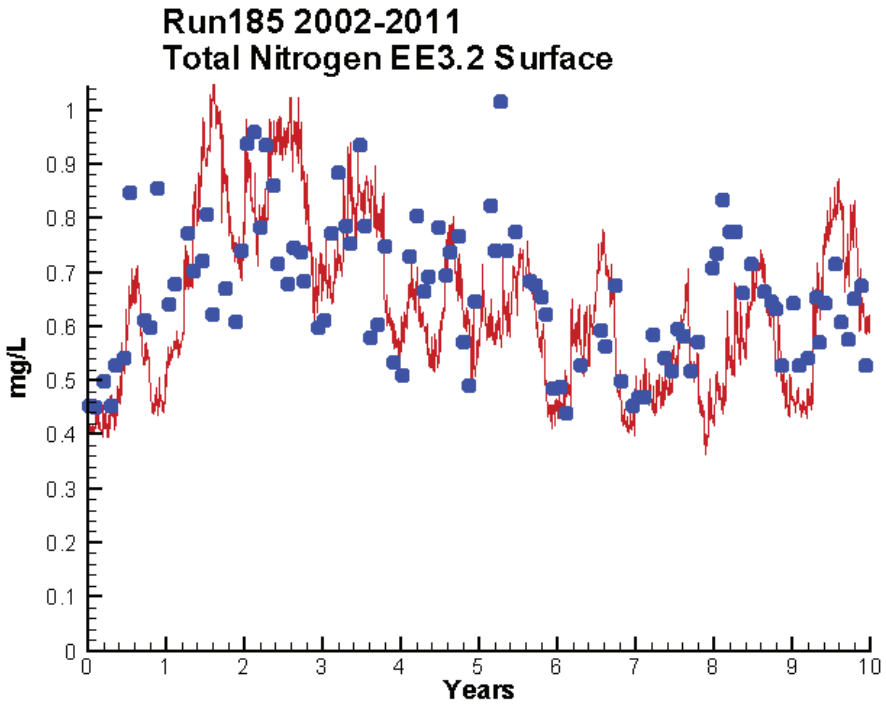


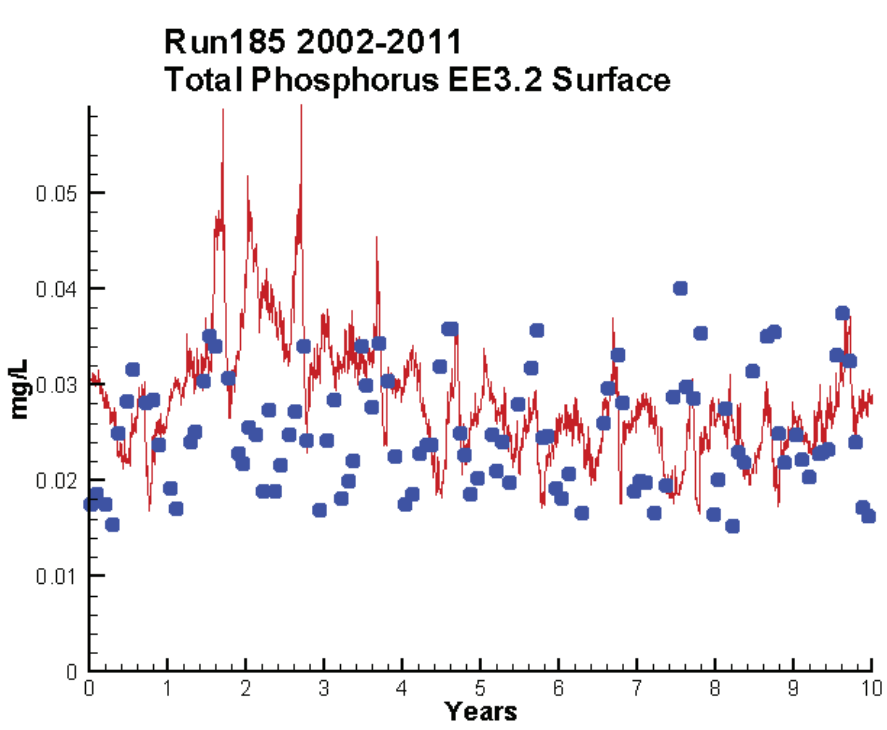




Station EE3.2

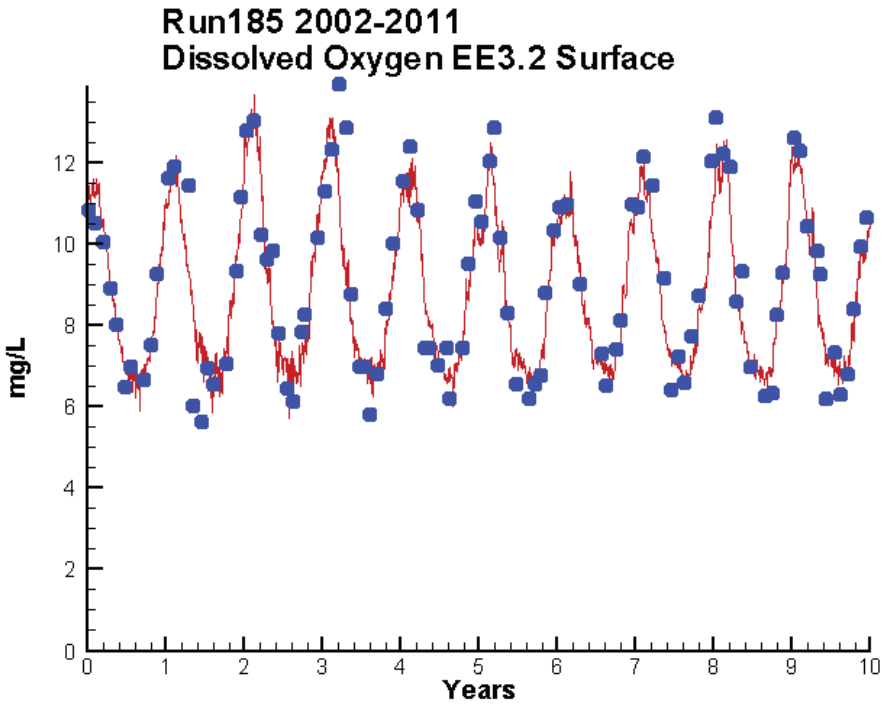


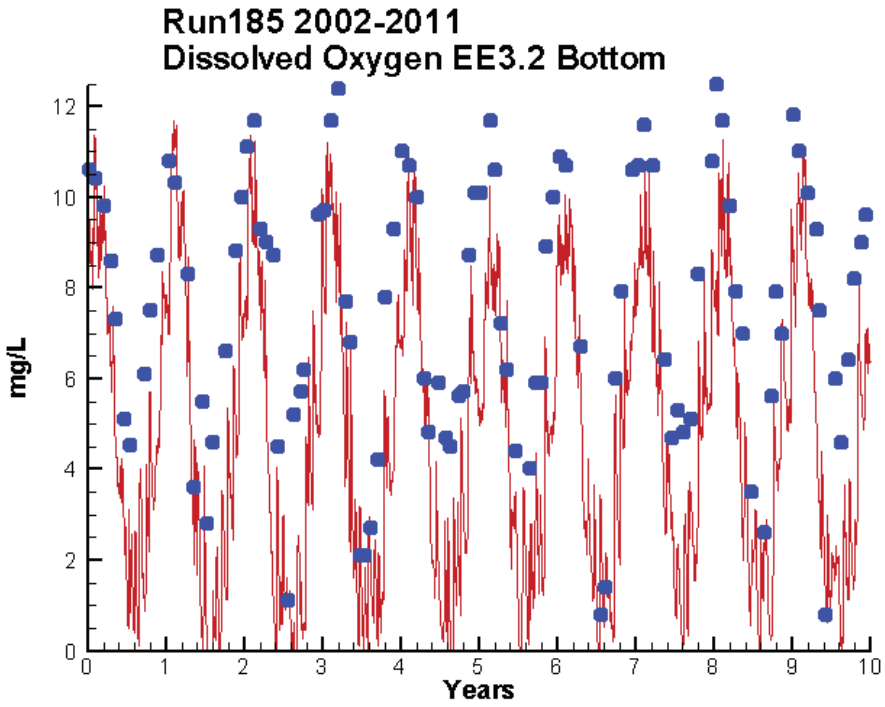


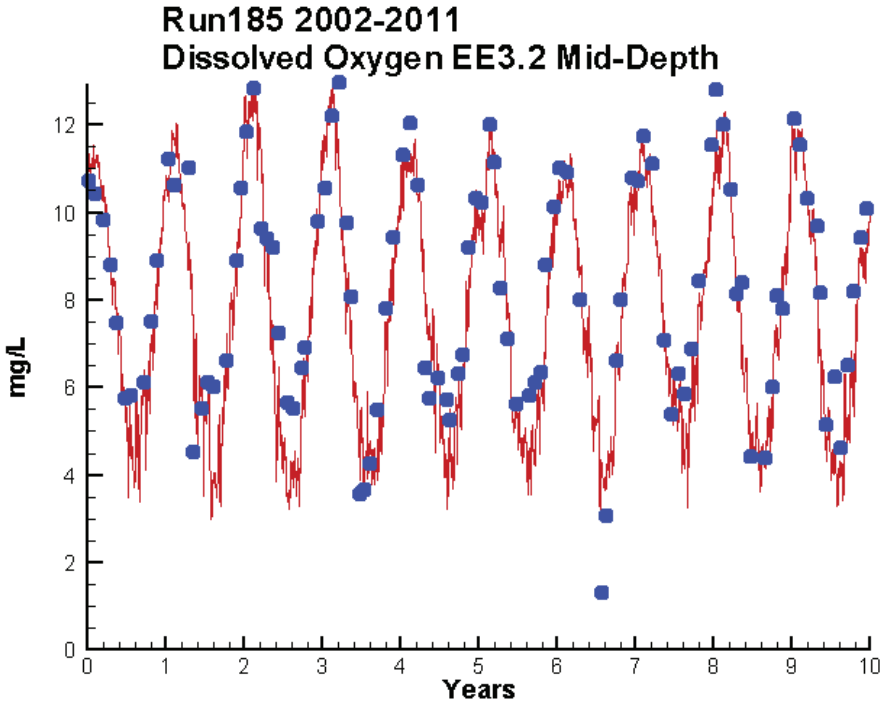


	Mean Difference	Absolute Mean Difference
Chl	-0.7605	3.9653
DIN	-0.0649	0.0744
KE	-0.0649	0.0744
DIP	0.0023	0.0033
TP	0.0031	0.0072
TN	-0.0251	0.1109

Station EE3.2

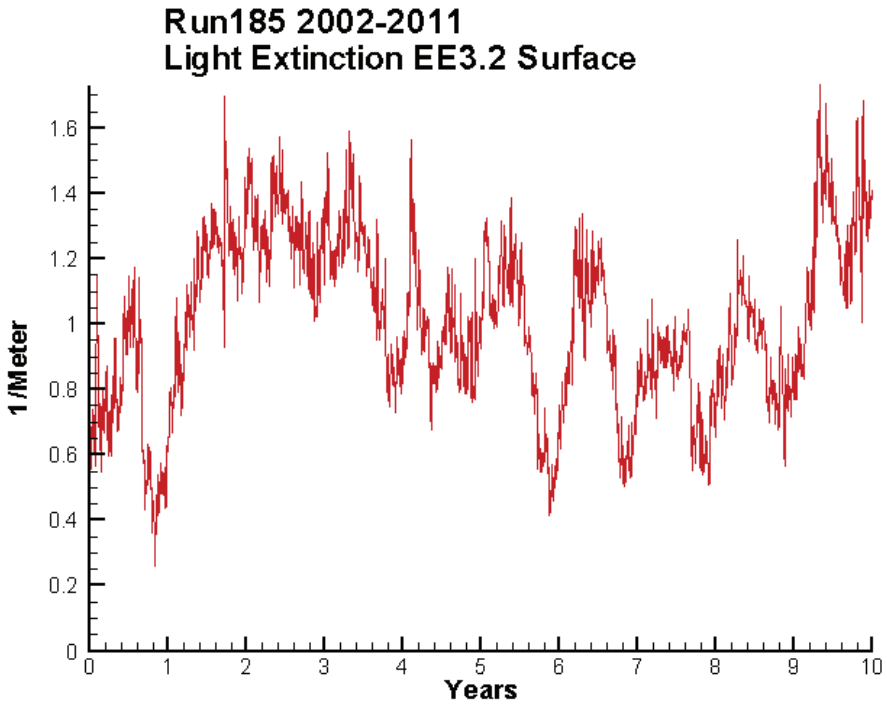


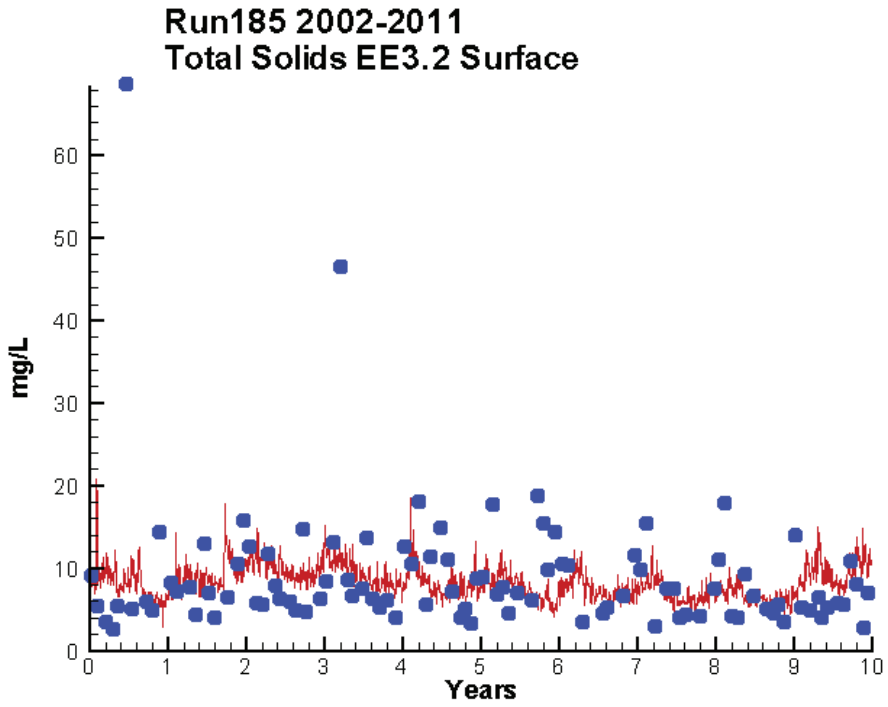


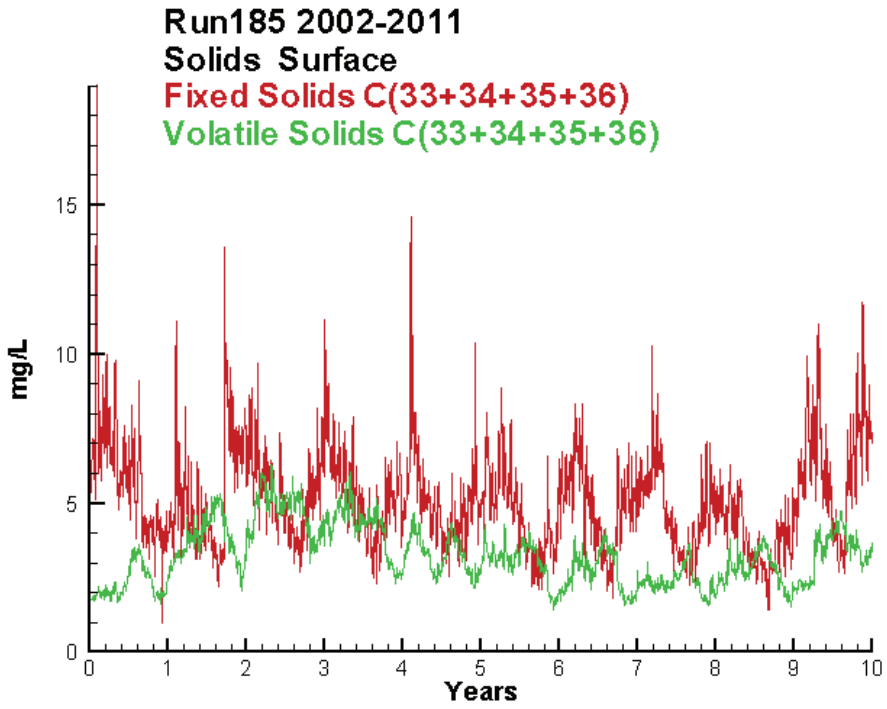


	Mean Difference	Absolute Mean Difference
Top DO	-0.1511	0.6103
Mid DO	-0.3919	0.7984
Bot DO	-2.7648	2.8475

Station EE3.2

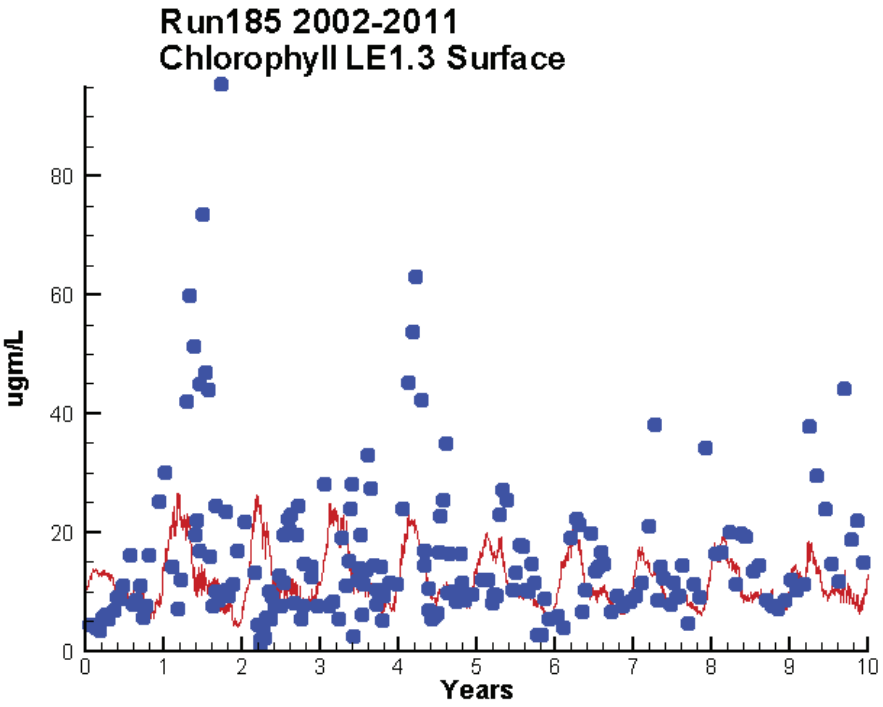


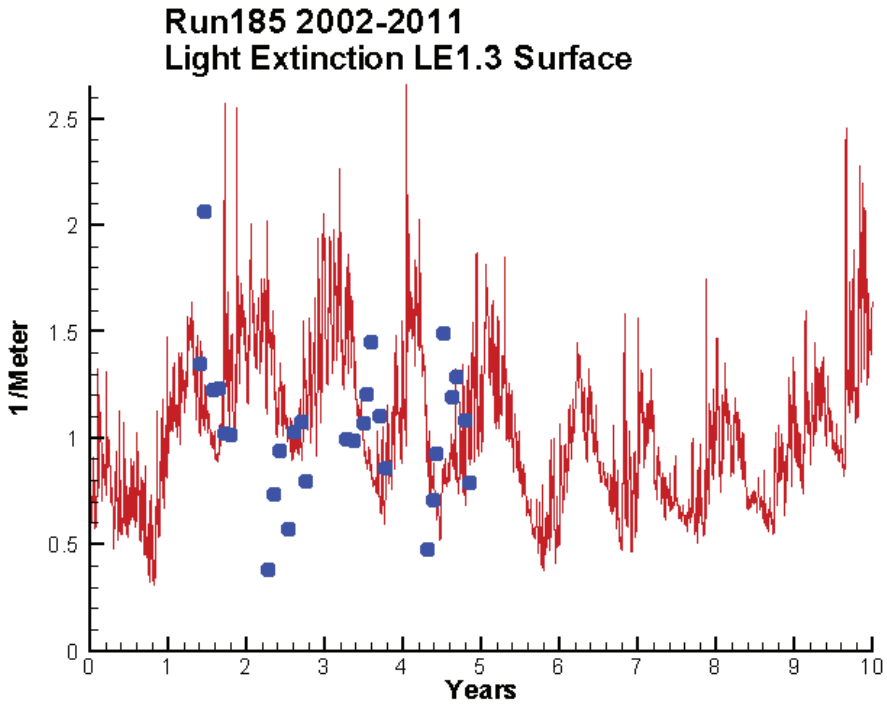


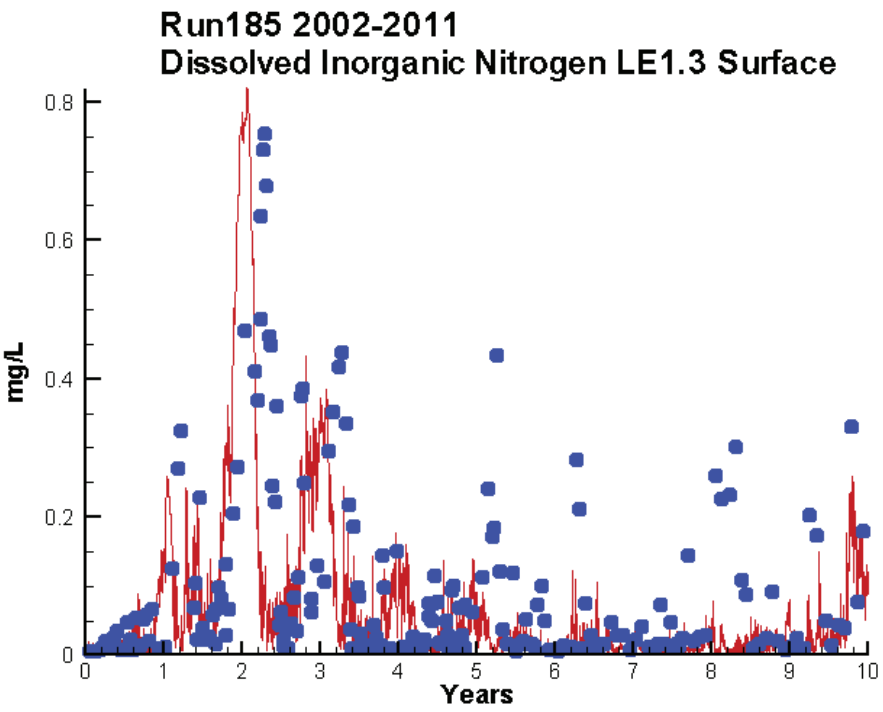


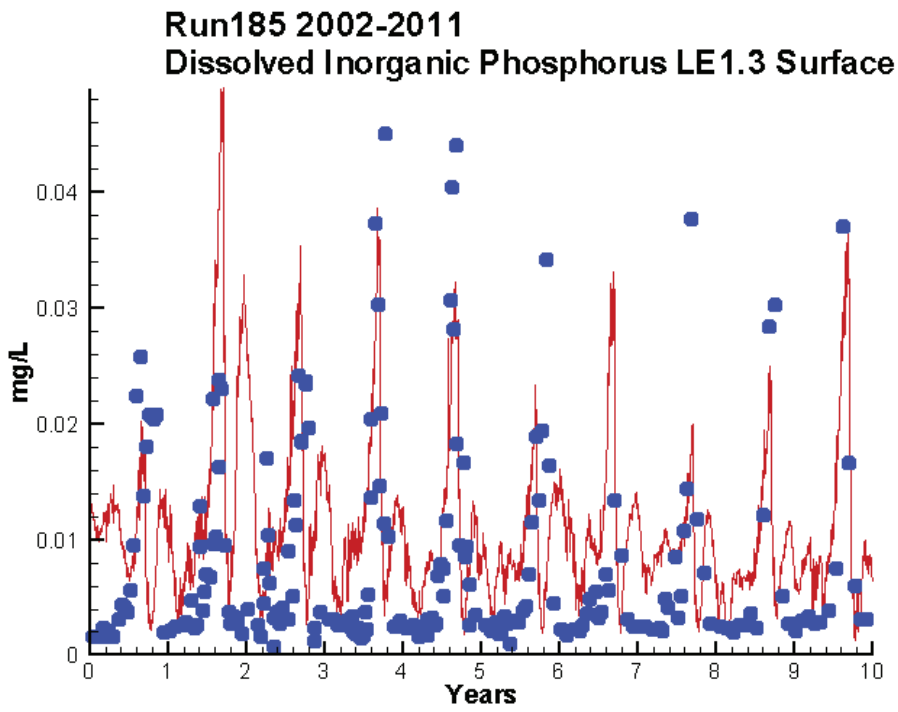
	Mean Difference	Absolute Mean Difference
KE	-0.0251	0.1109
TSS	-0.5868	4.4147

Station LE1.3

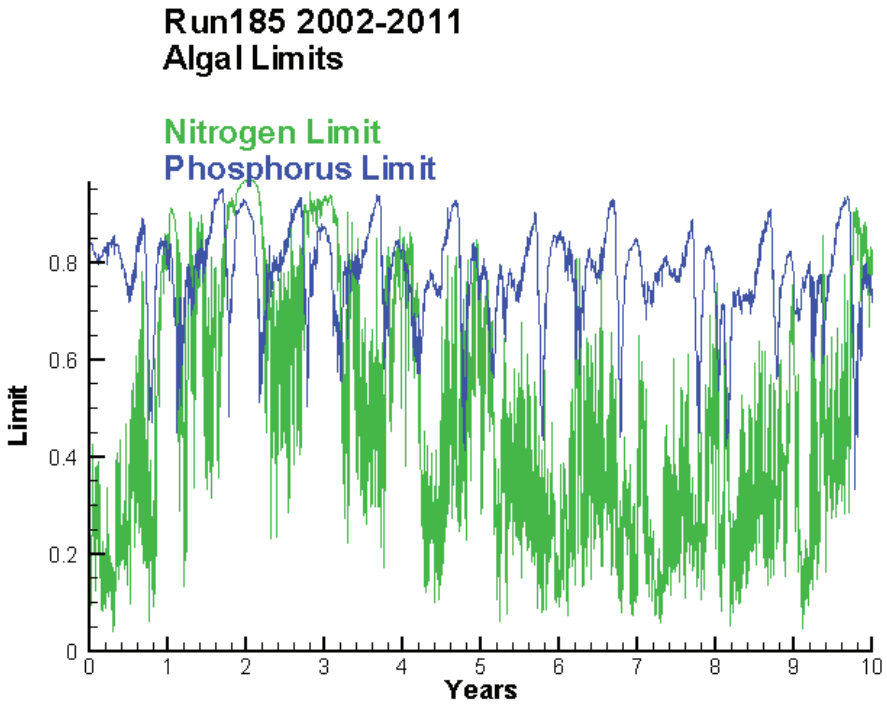


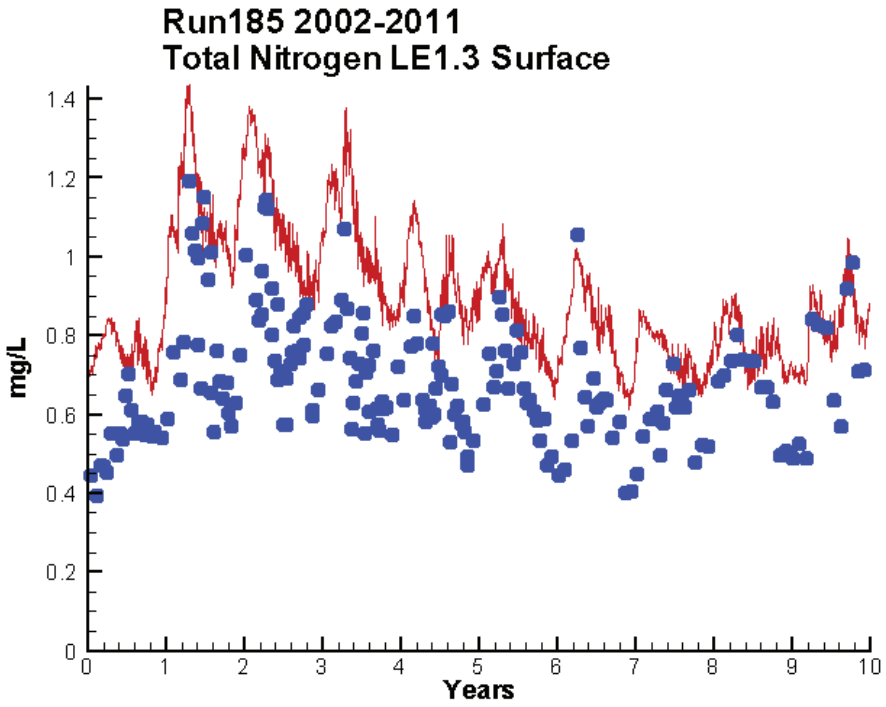


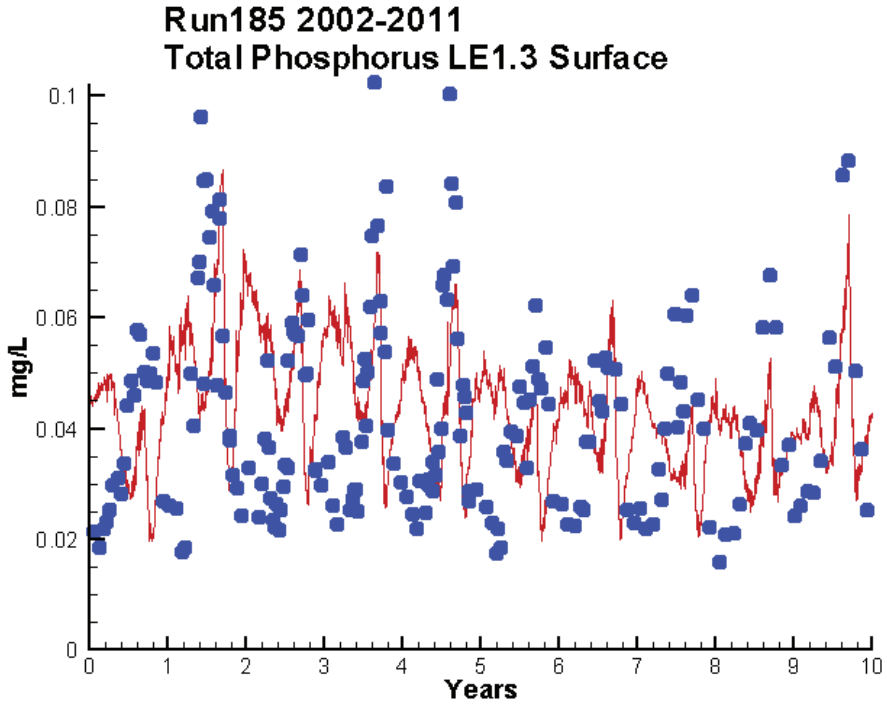




Station LE1.3

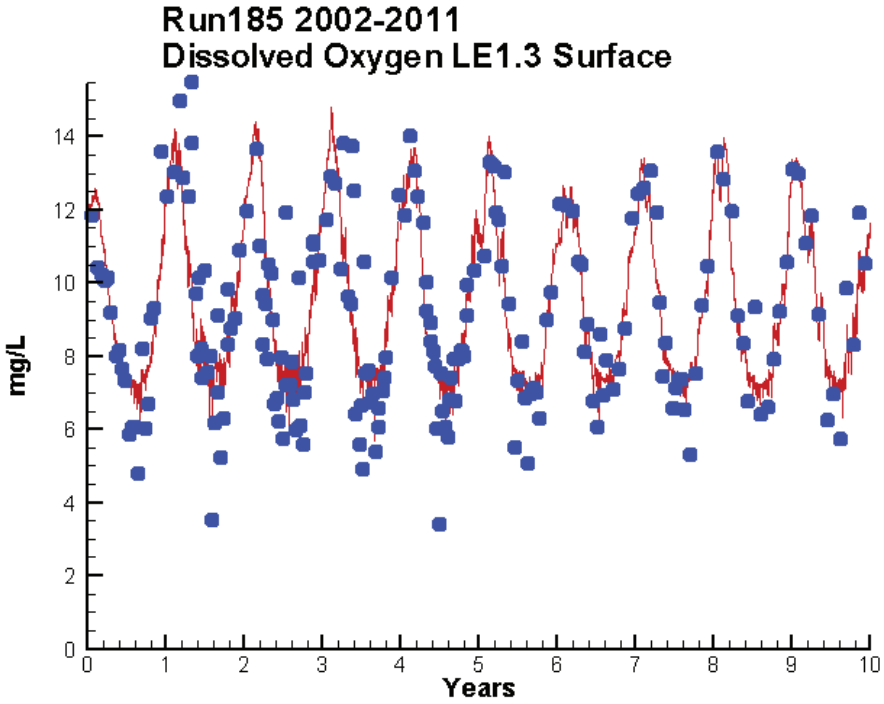


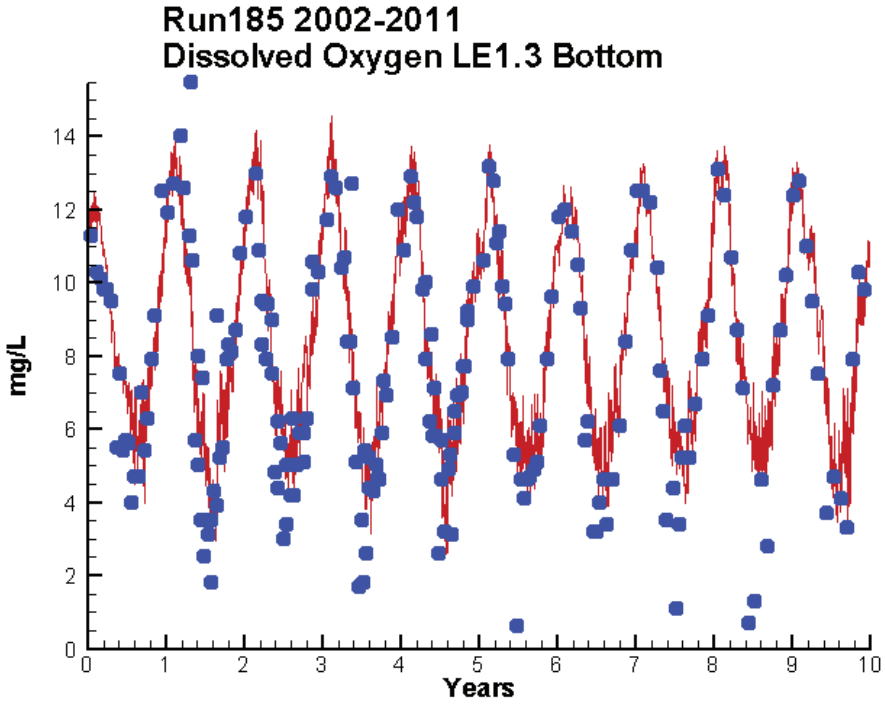


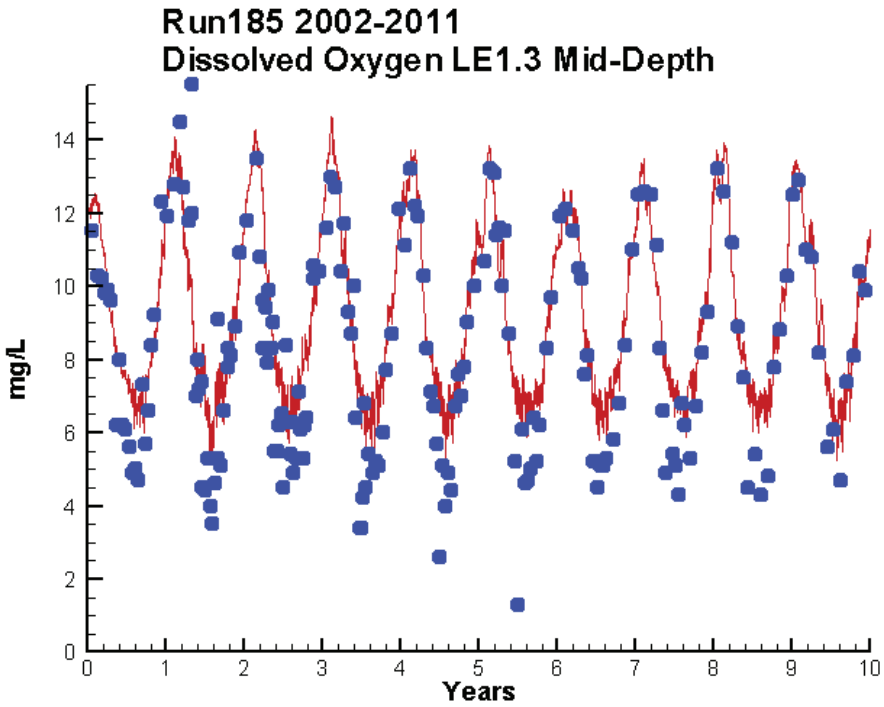


	Mean Difference	Absolute Mean Difference
Chl	-3.8243	8.4363
DIN	-0.0432	0.0841
KE	-0.0127	0.3889
DIP	0.0034	0.0075
TP	0.0015	0.0170
TN	0.2367	0.2395

Station LE1.3

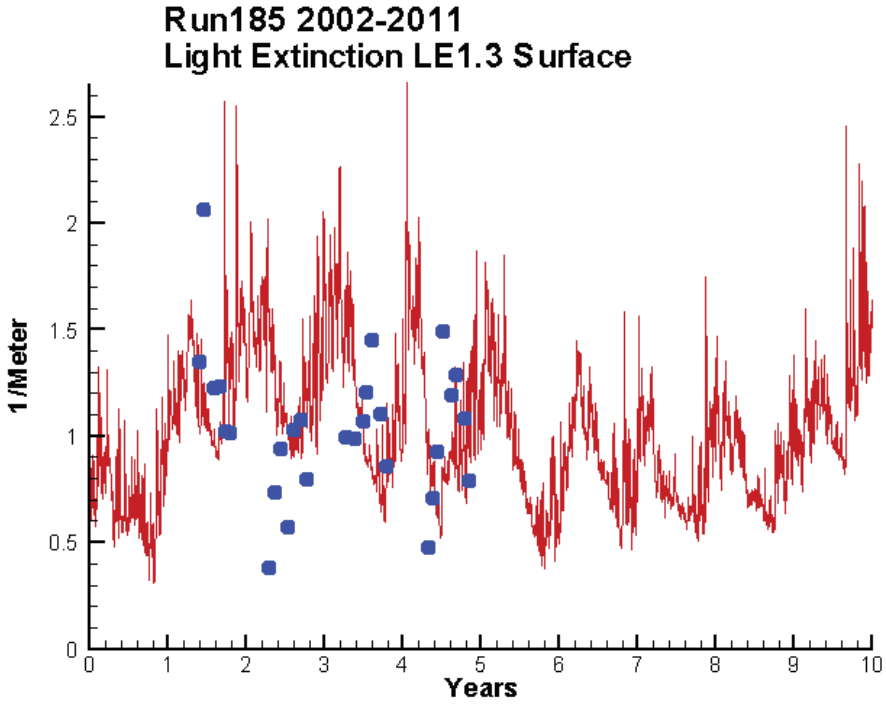


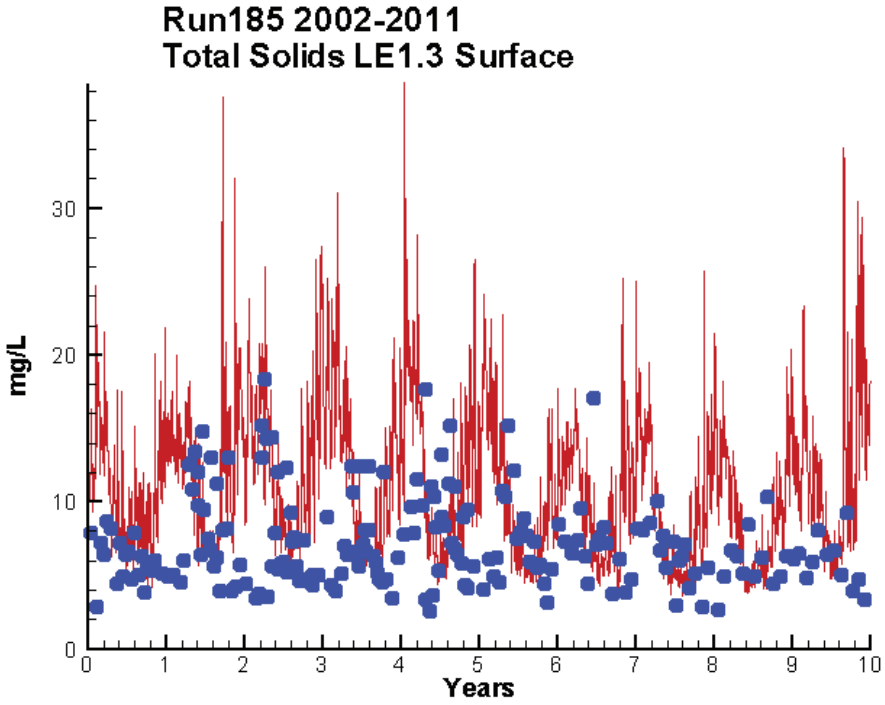


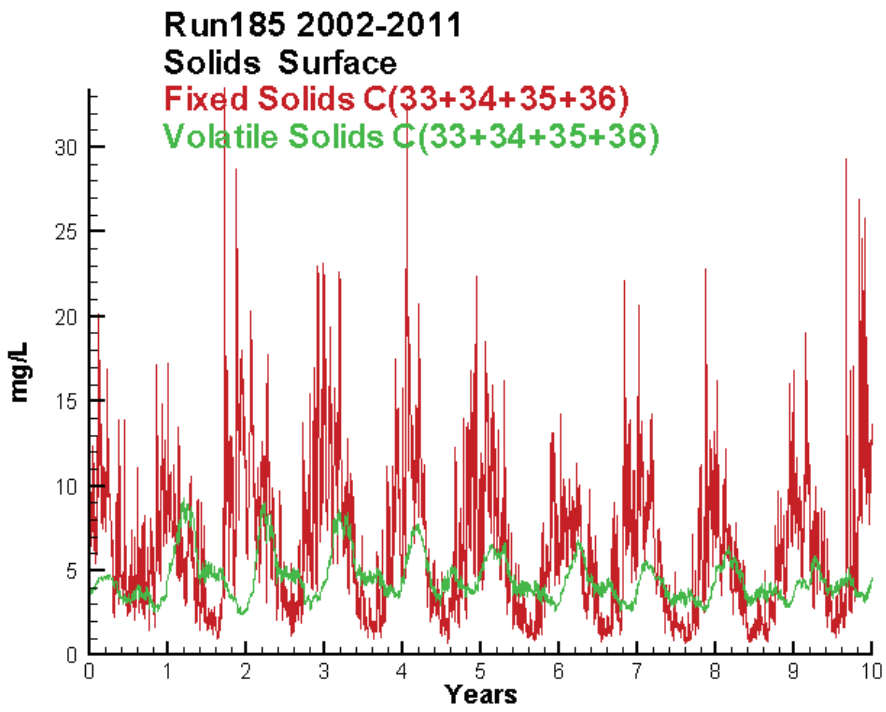


	Mean Difference	Absolute Mean Difference
Top DO	0.1149	1.0311
Mid DO	0.8379	1.2320
Bot DO	0.5515	1.1868

Station LE1.3

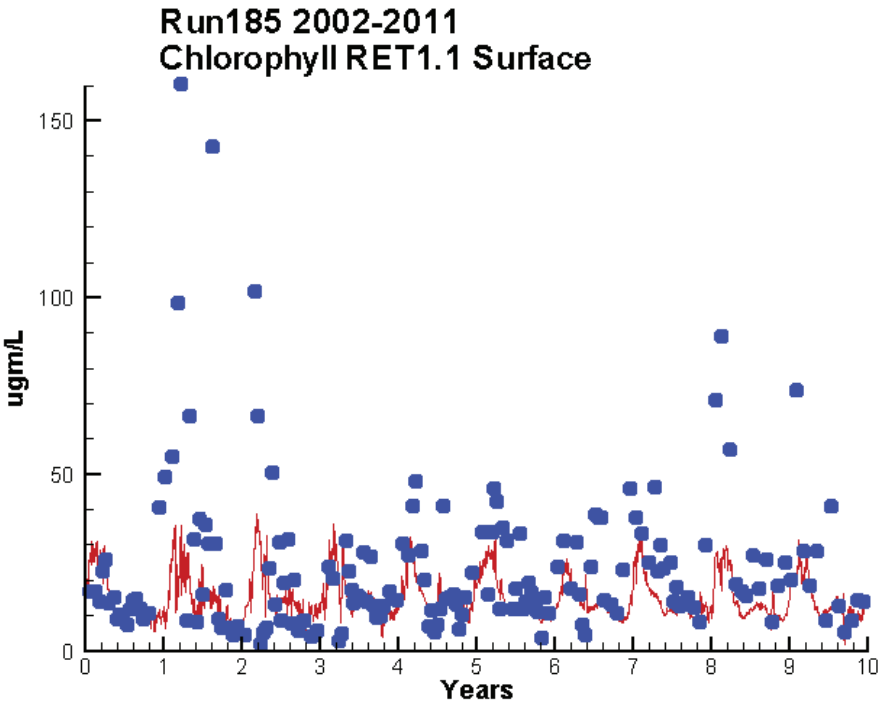


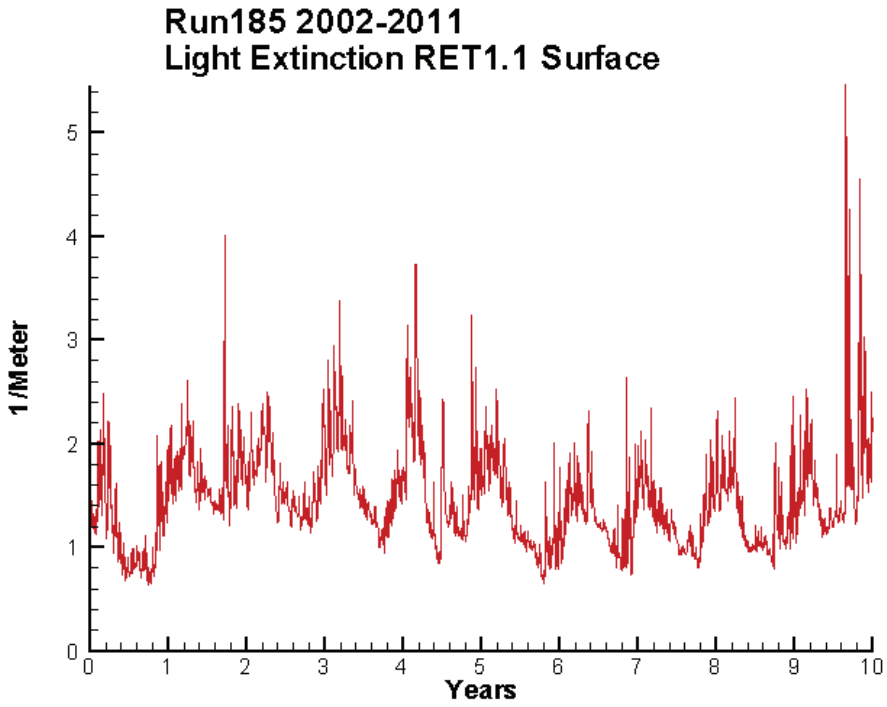


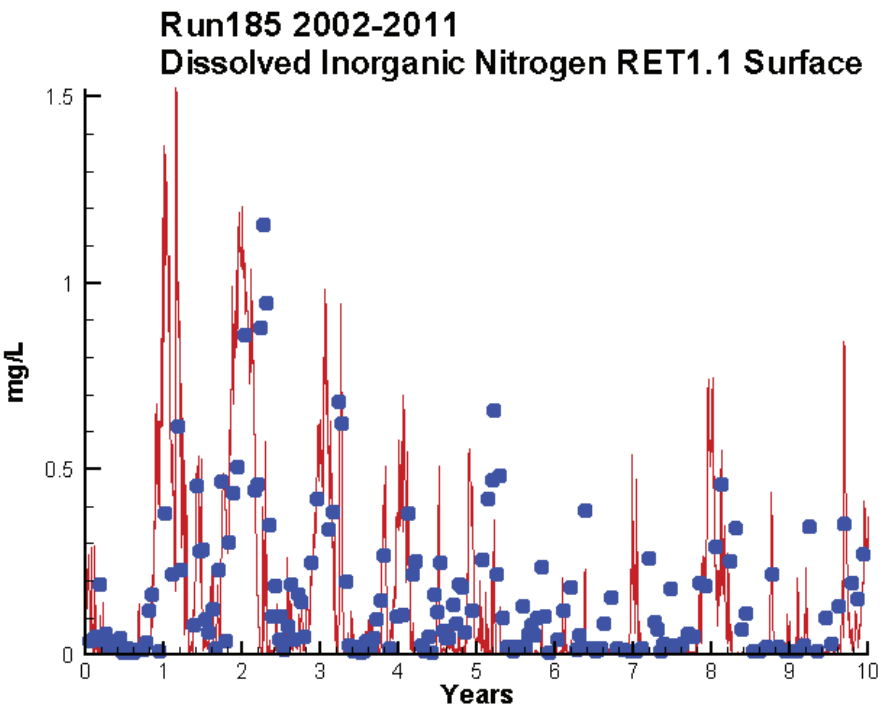


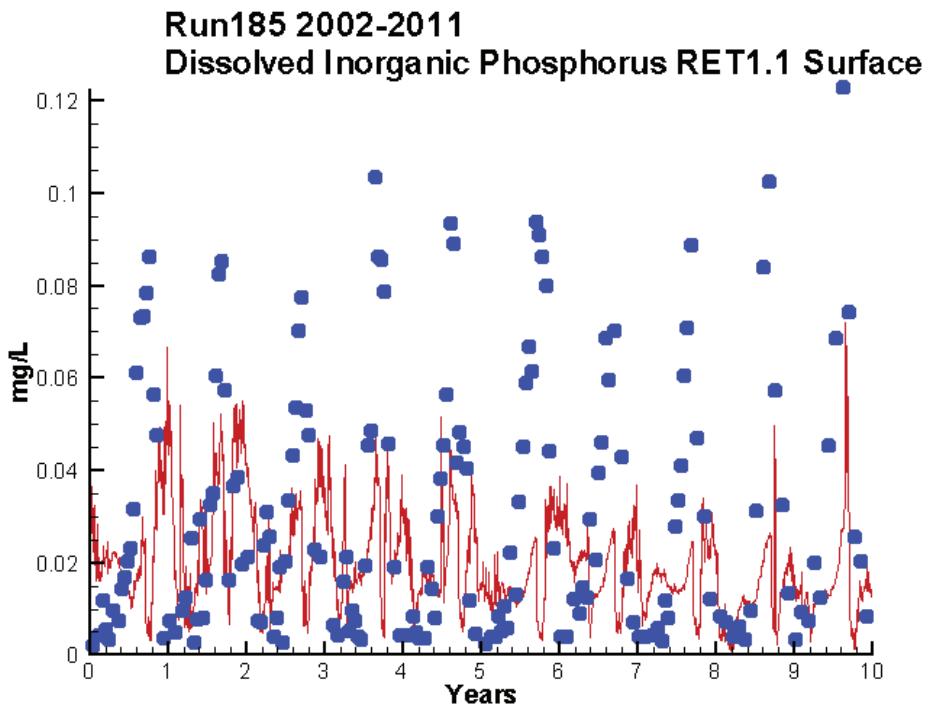
	Mean Difference	Absolute Mean Difference
KE	-0.0127	0.3889
TSS	3.4025	5.0200

Station RET1.1

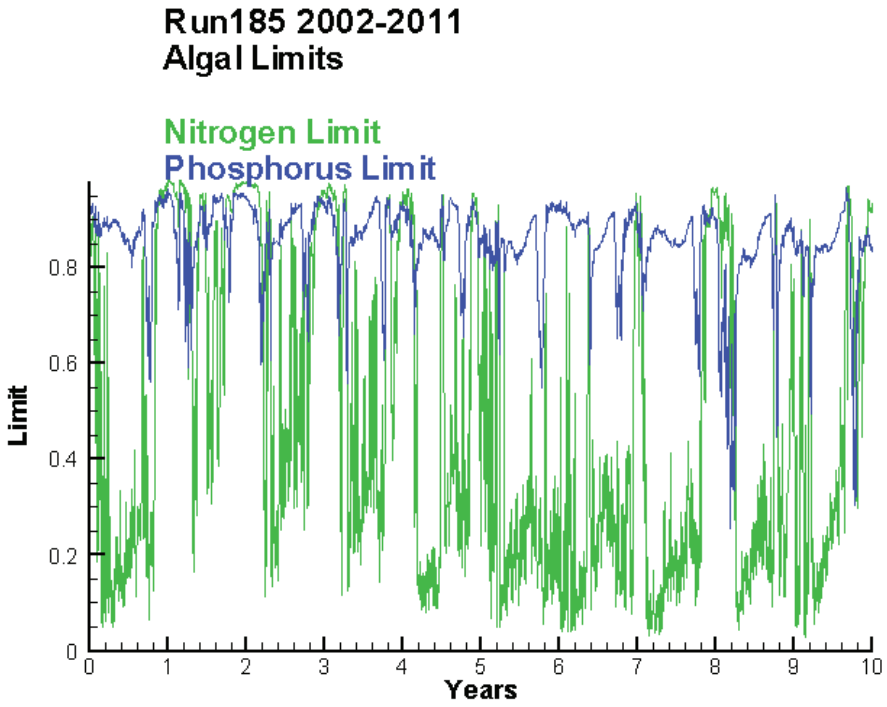


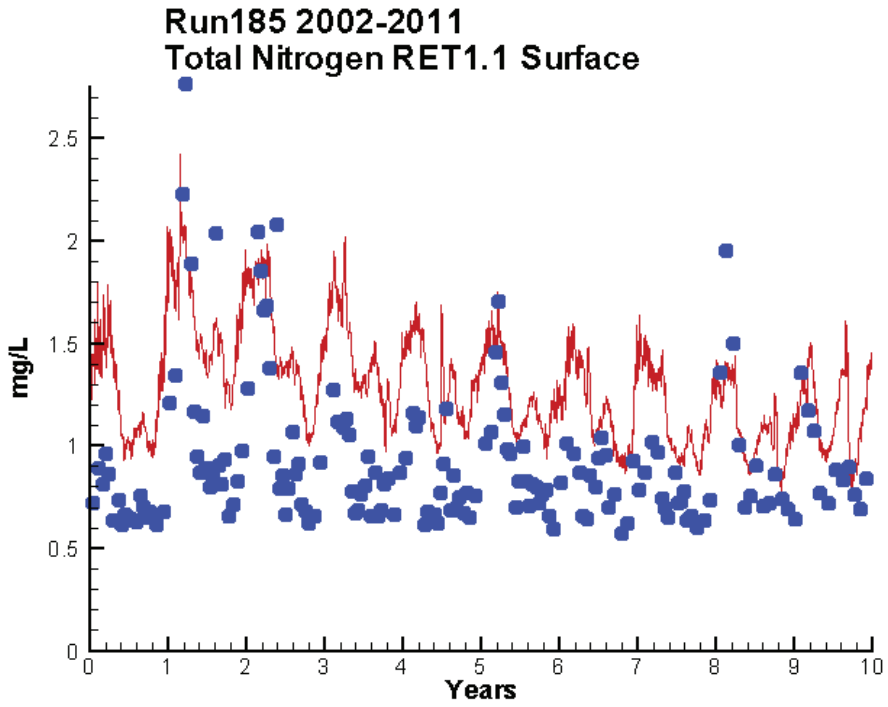


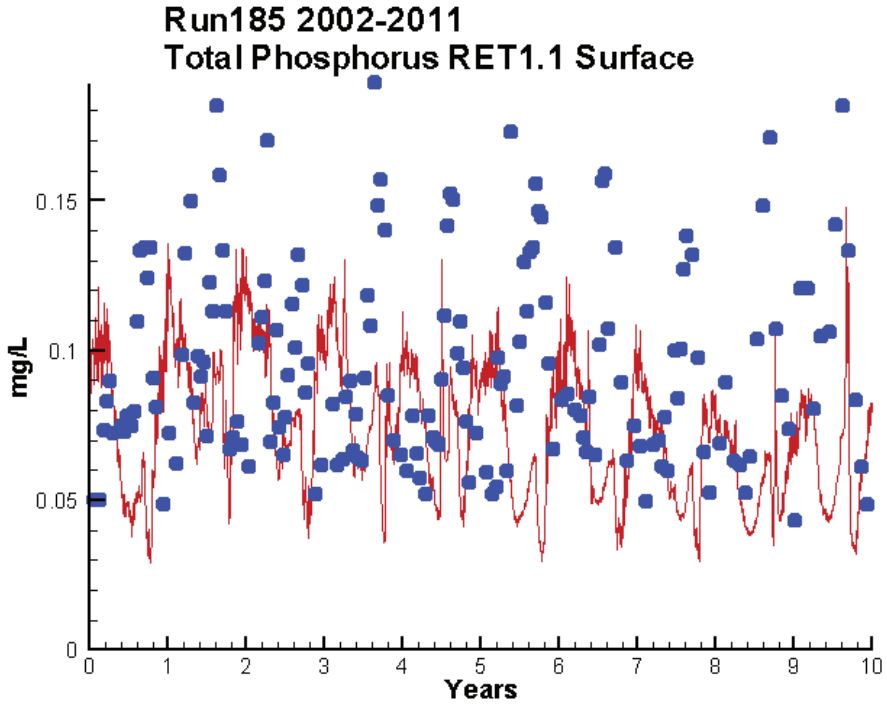




Station RET1.1

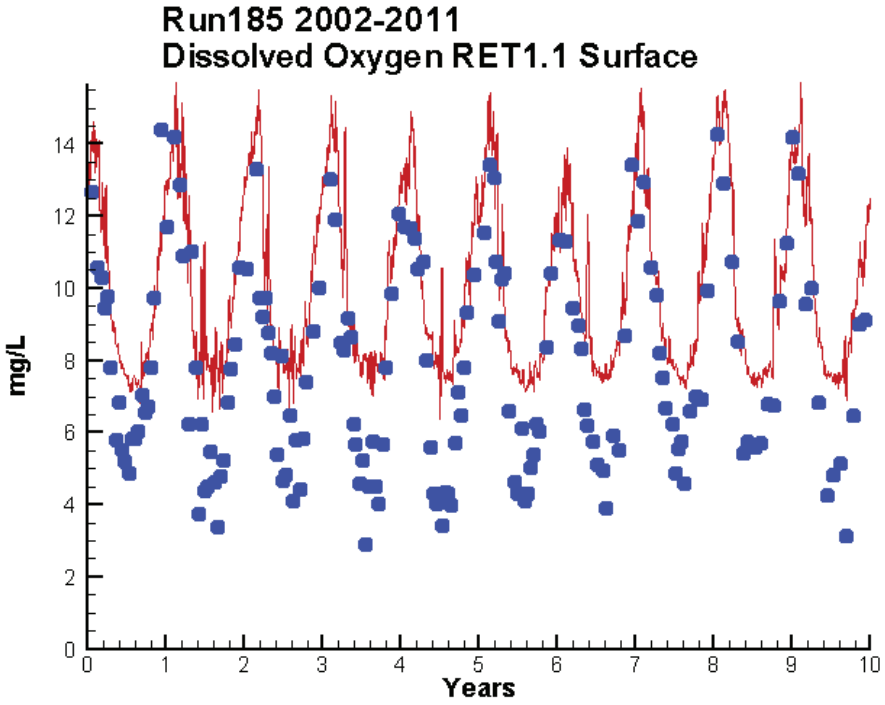


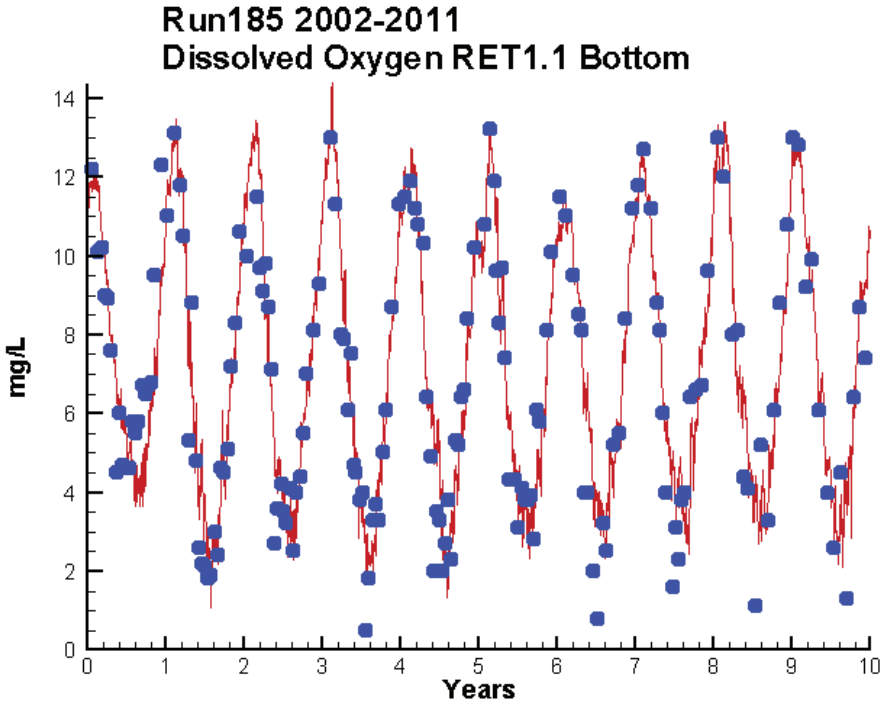




	Mean Difference	Absolute Mean Difference
Chl	-8.2306	12.2128
DIN	-0.0382	0.1259
KE	-0.0382	0.1259
DIP	-0.0116	0.0225
TP	-0.0215	0.0383
TN	0.3962	0.4336

Station RET1.1

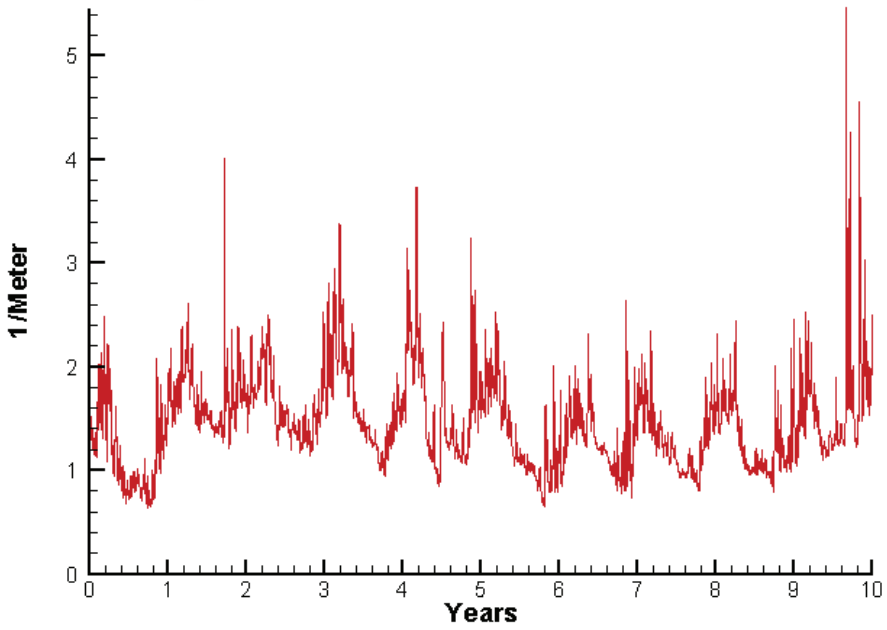




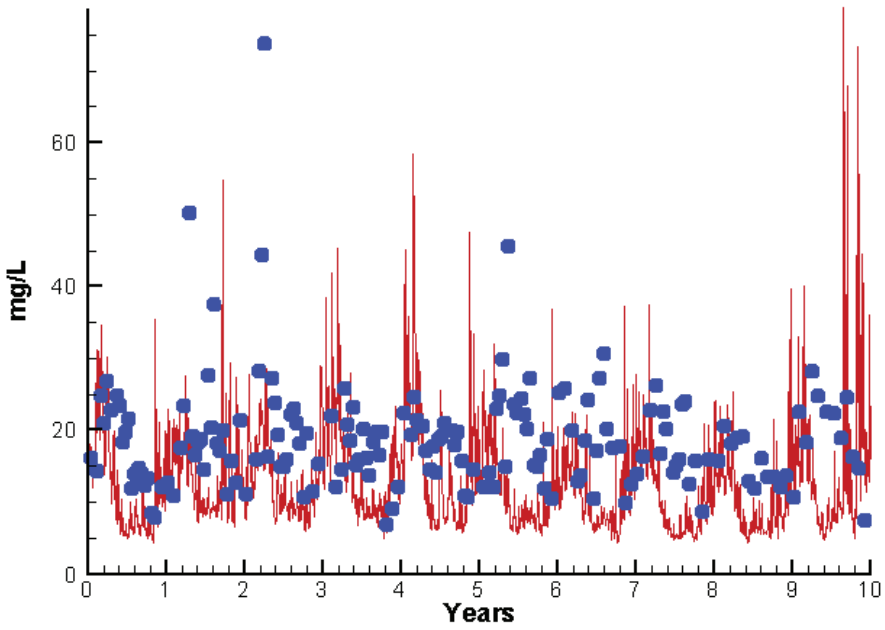
	Mean Difference	Absolute Mean Difference
Top DO	2.0447	2.1593
Bot DO	0.2438	0.9146

Station RET1.1

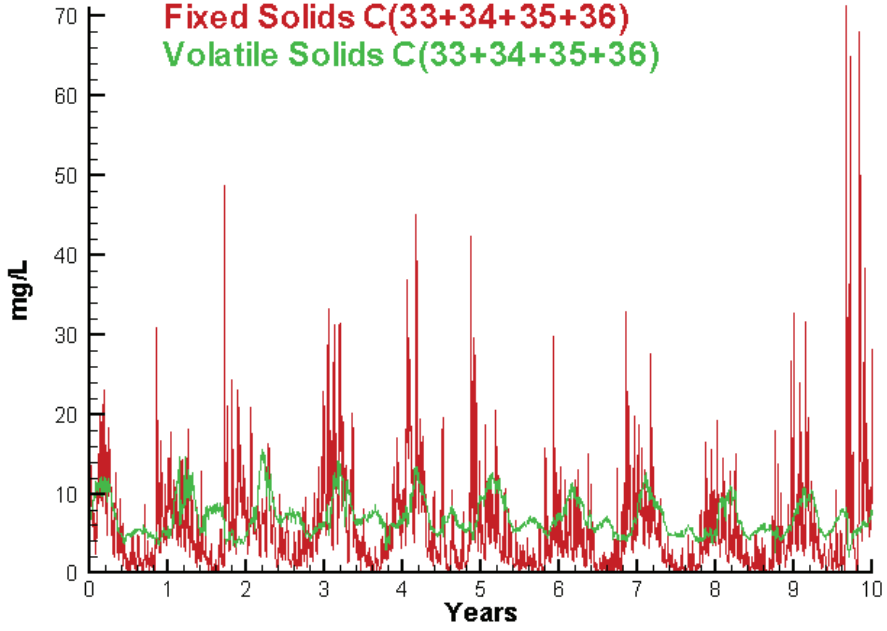
Run185 2002-2011
Light Extinction RET1.1 Surface



Run185 2002-2011
Total Solids RET1.1 Surface

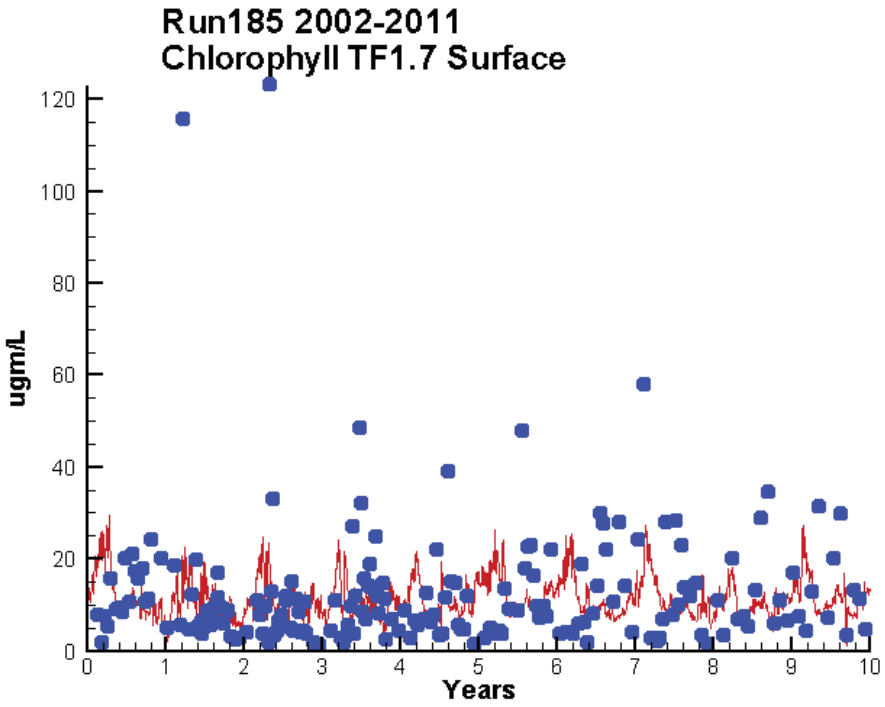


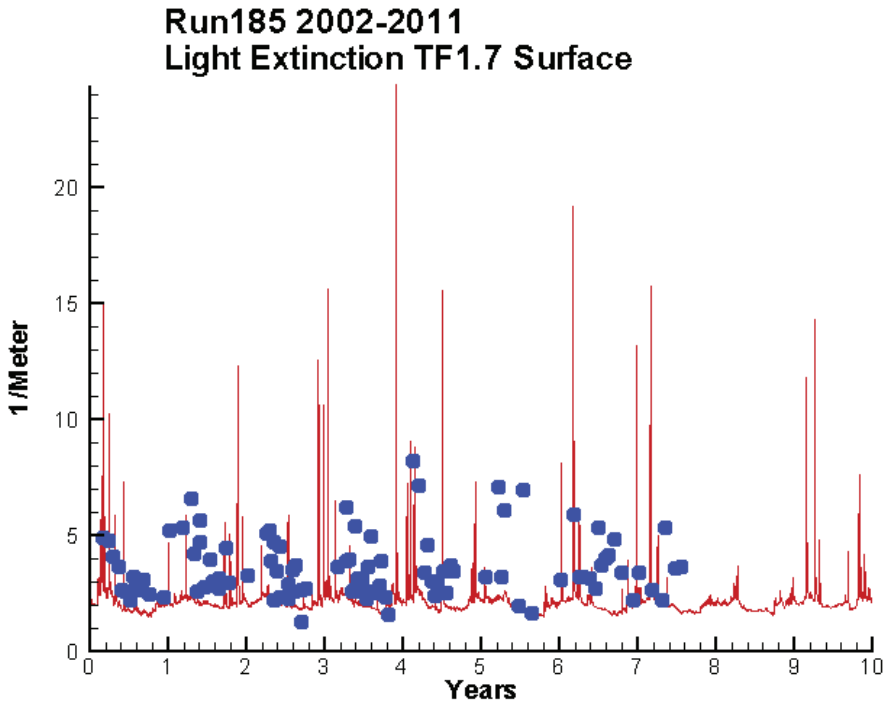
Run185 2002-2011
Solids Surface
Fixed Solids C(33+34+35+36)
Volatile Solids C(33+34+35+36)

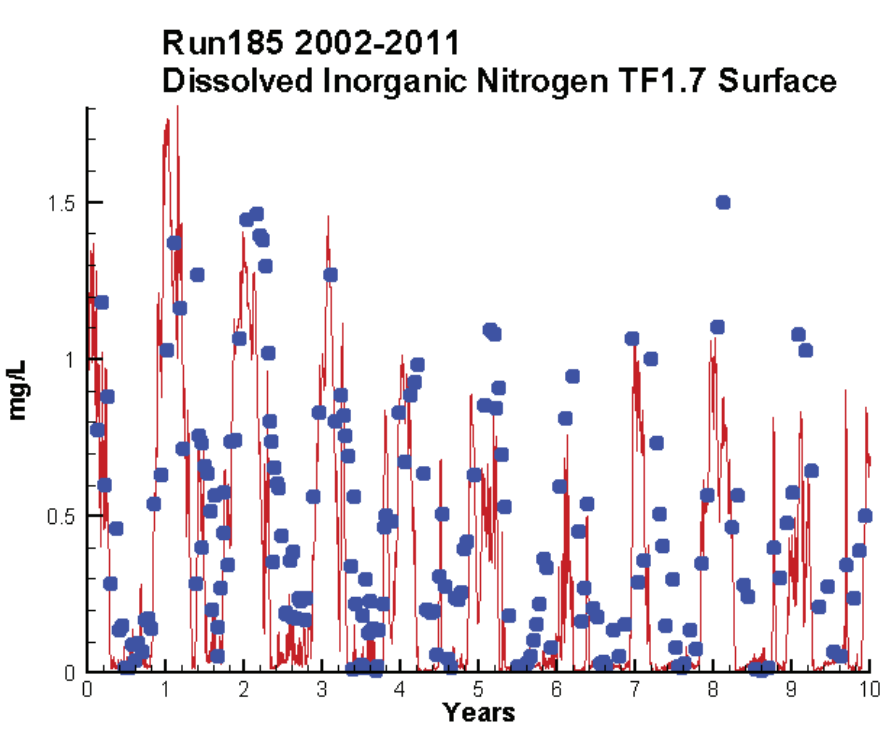


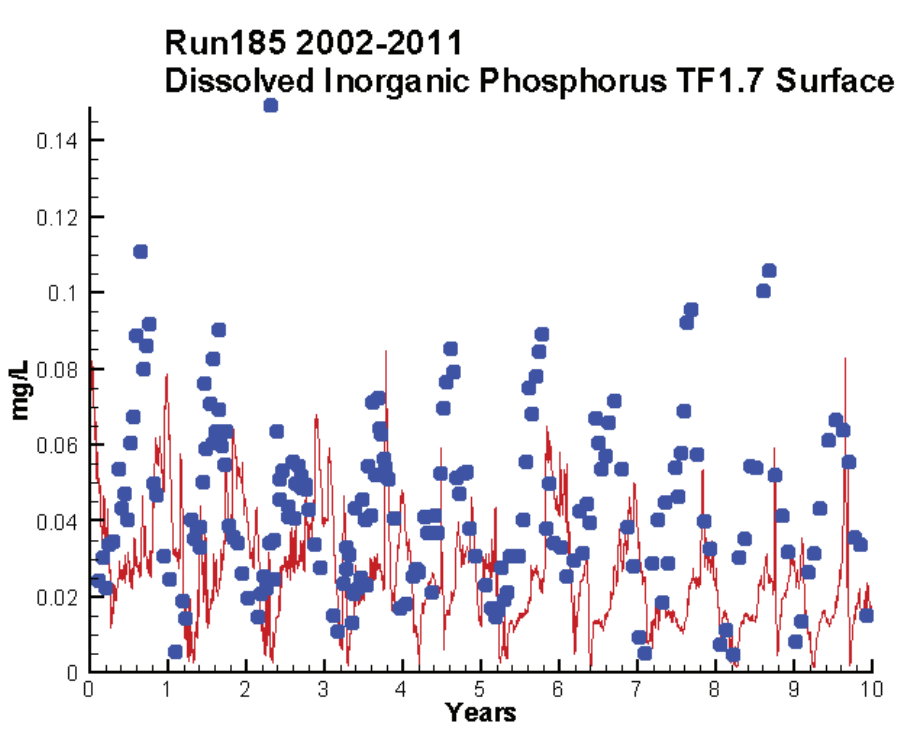
	Mean Difference	Absolute Mean Difference
KE	0.3962	0.4336
TSS	-6.3931	8.8450

Station TF1.7

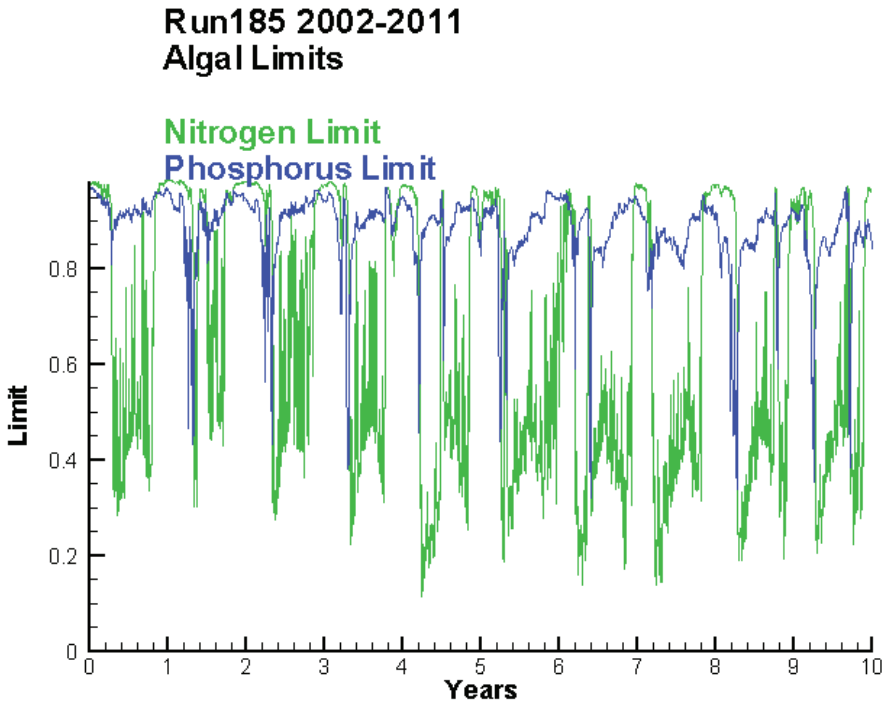


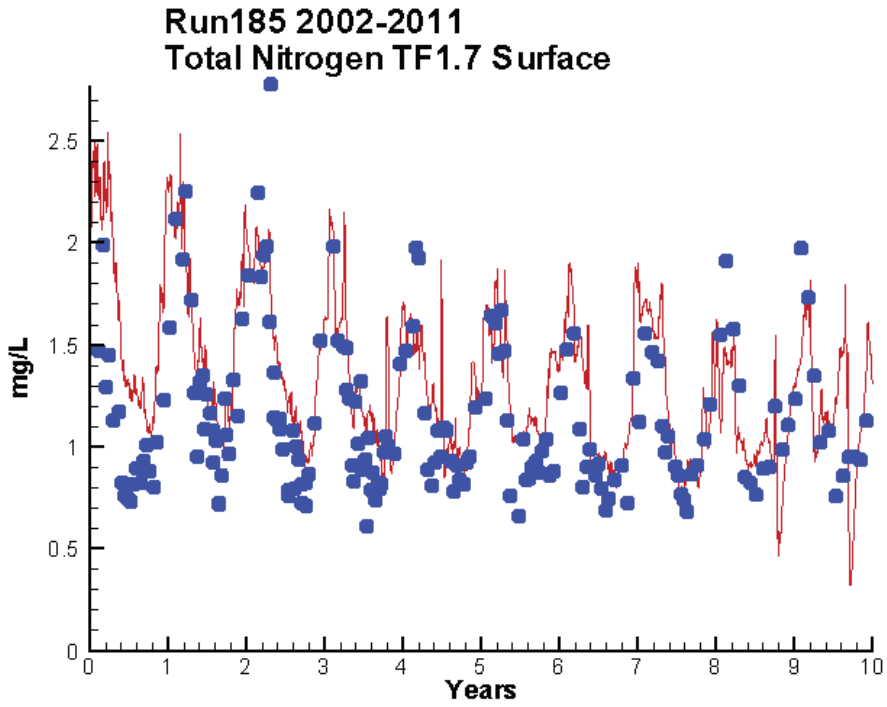


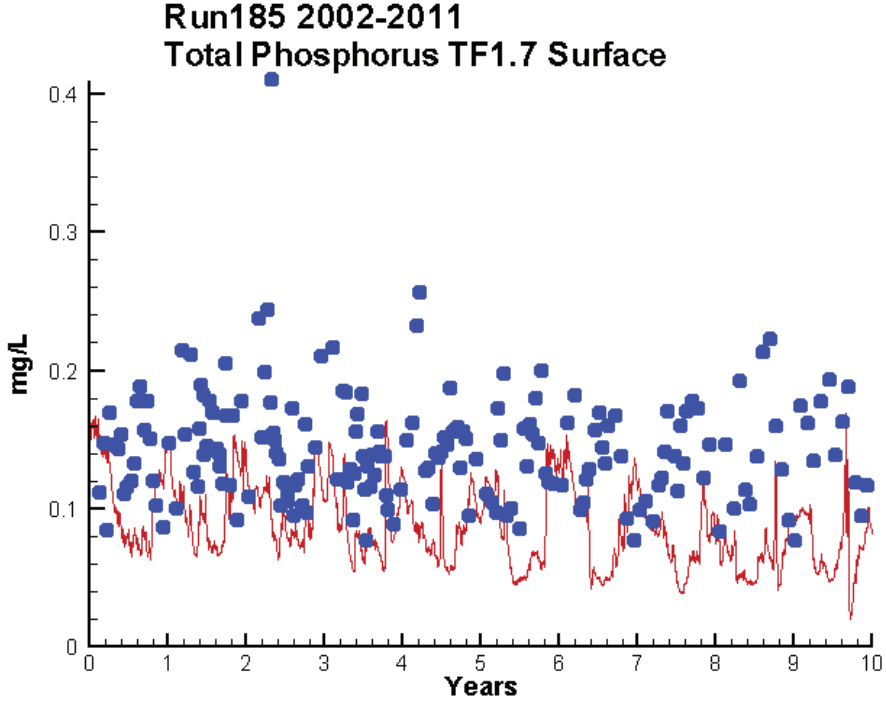




Station TF1.7

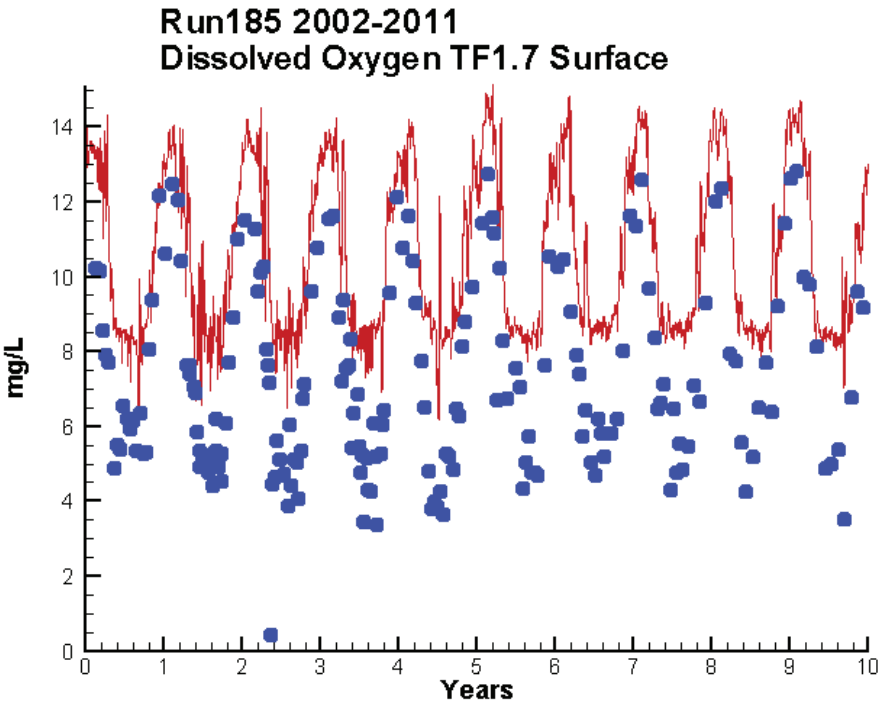






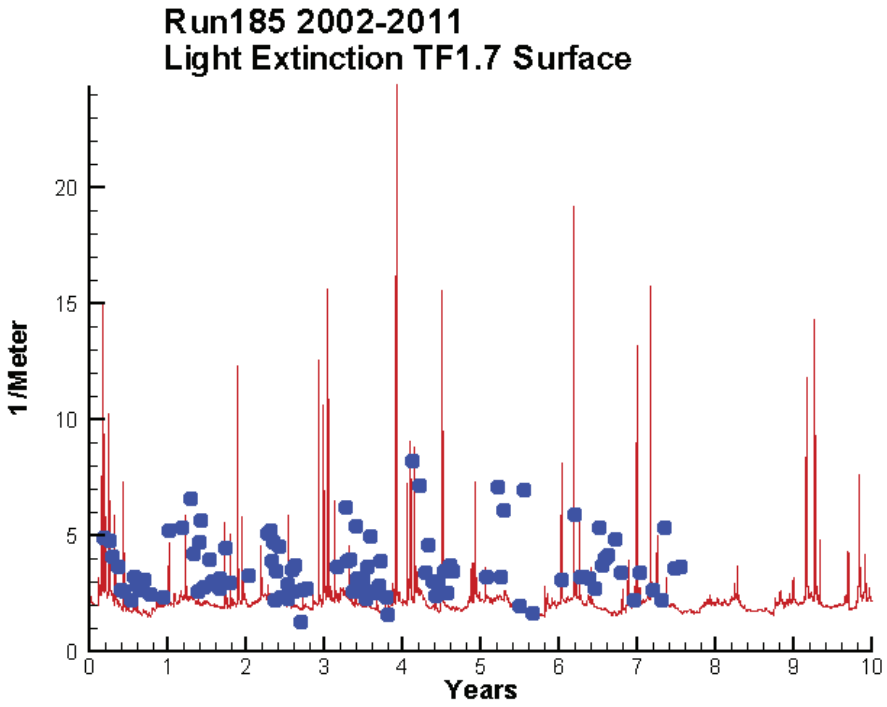
	Mean Difference	Absolute Mean Difference
Chl	-1.0565	8.9718
DIN	-0.1878	0.2470
KE	-1.4963	1.5698
DIP	-0.0187	0.0262
TP	-0.0572	0.0628
TN	0.1820	0.2590

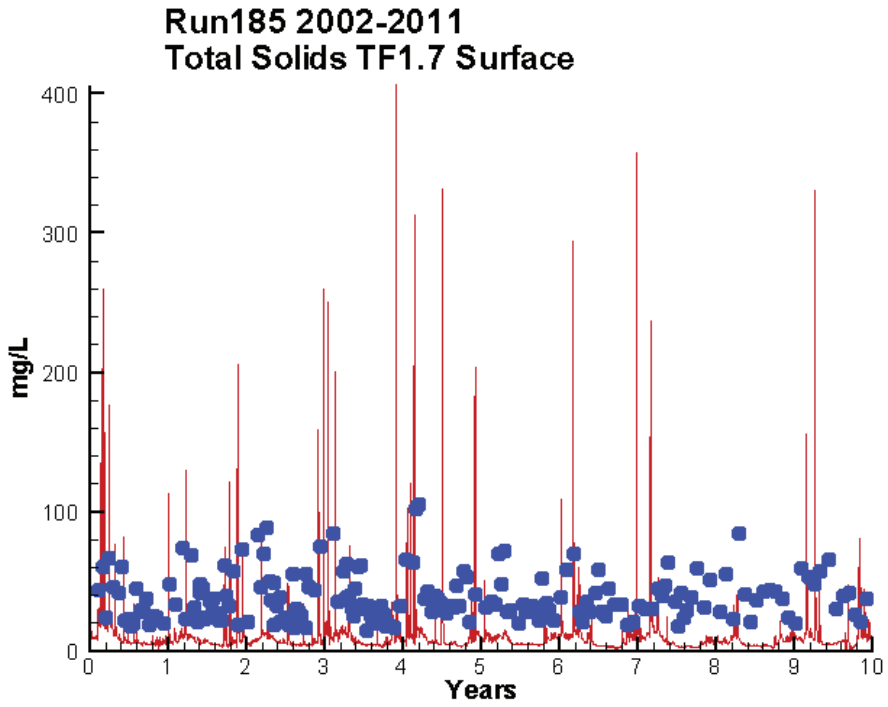
Station TF1.7

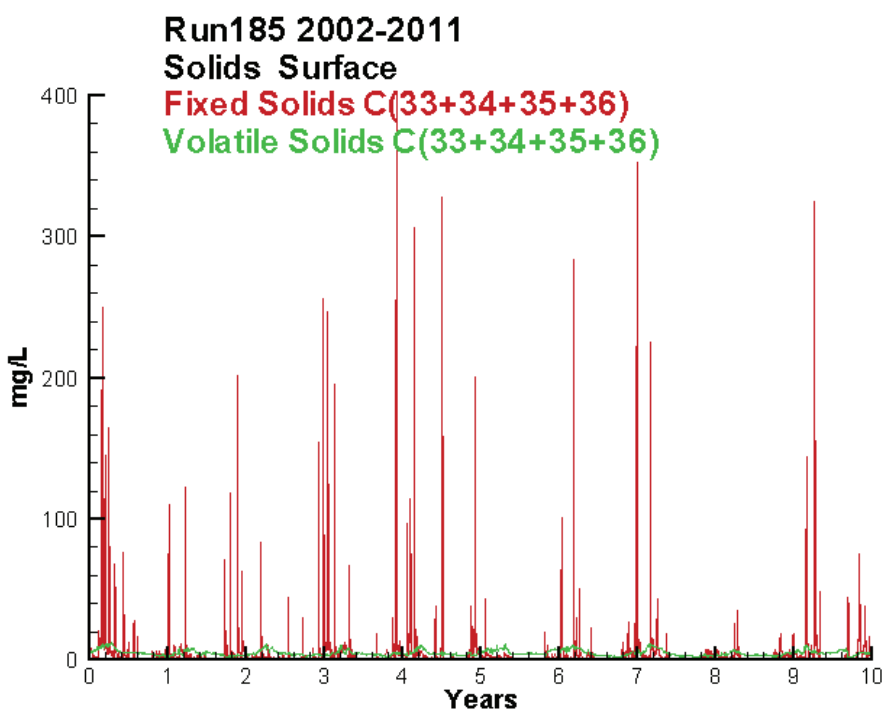


	Mean Difference	Absolute Mean Difference
Top DO	2.9379	2.9394

Station TF1.7

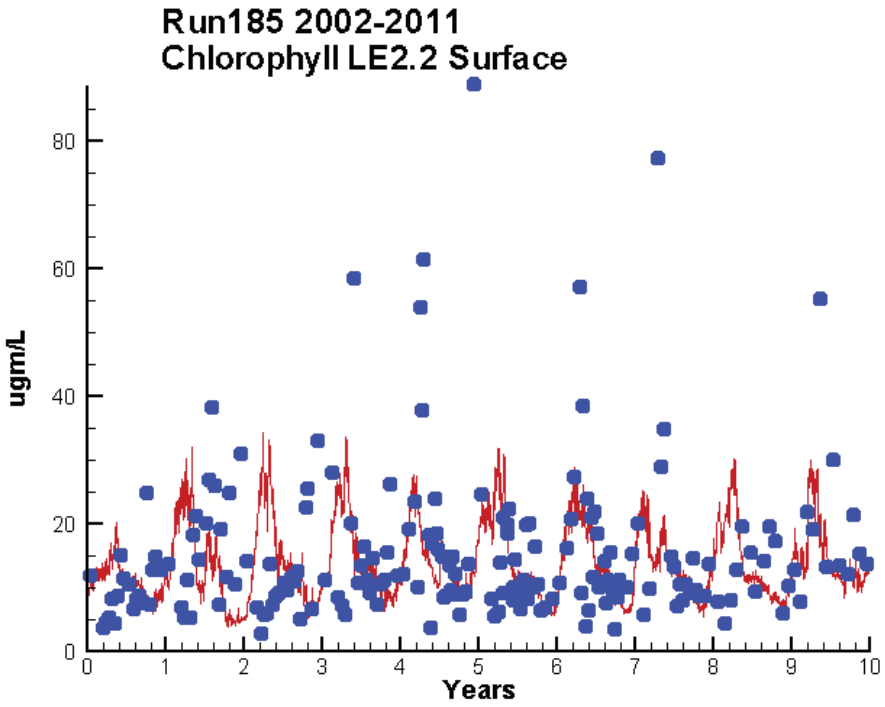


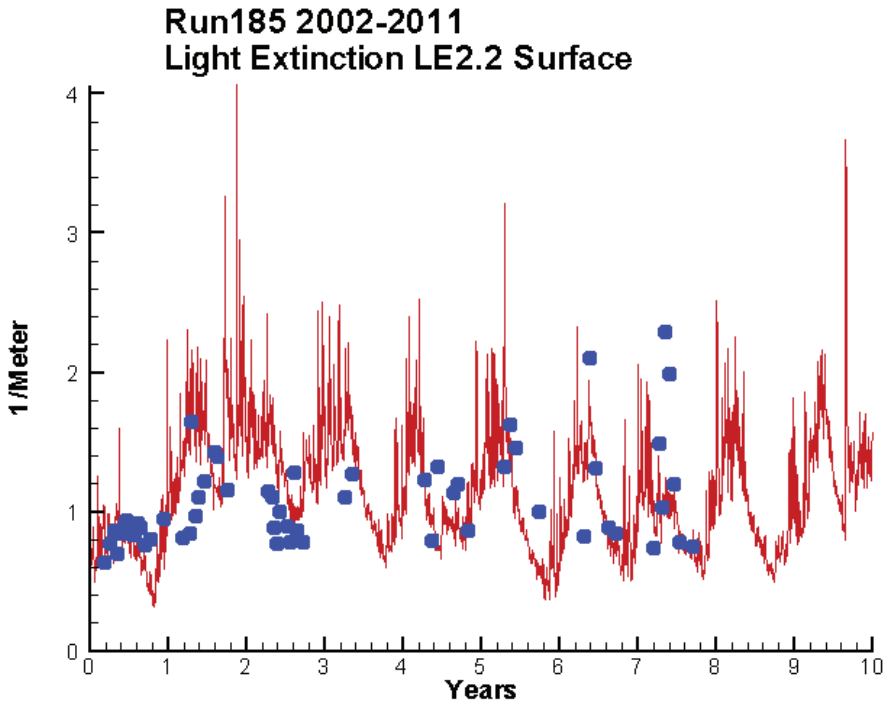


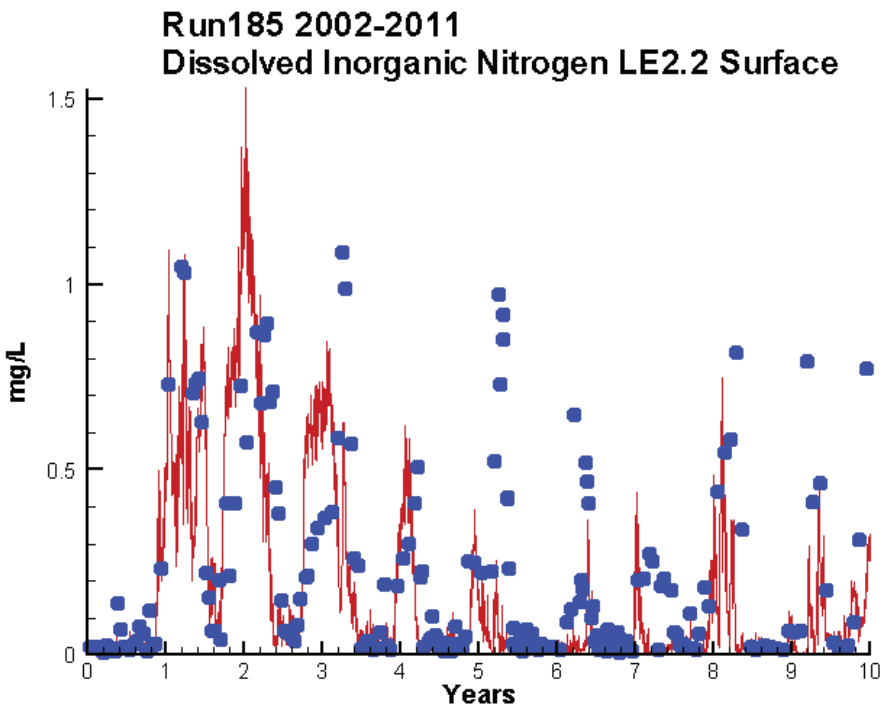


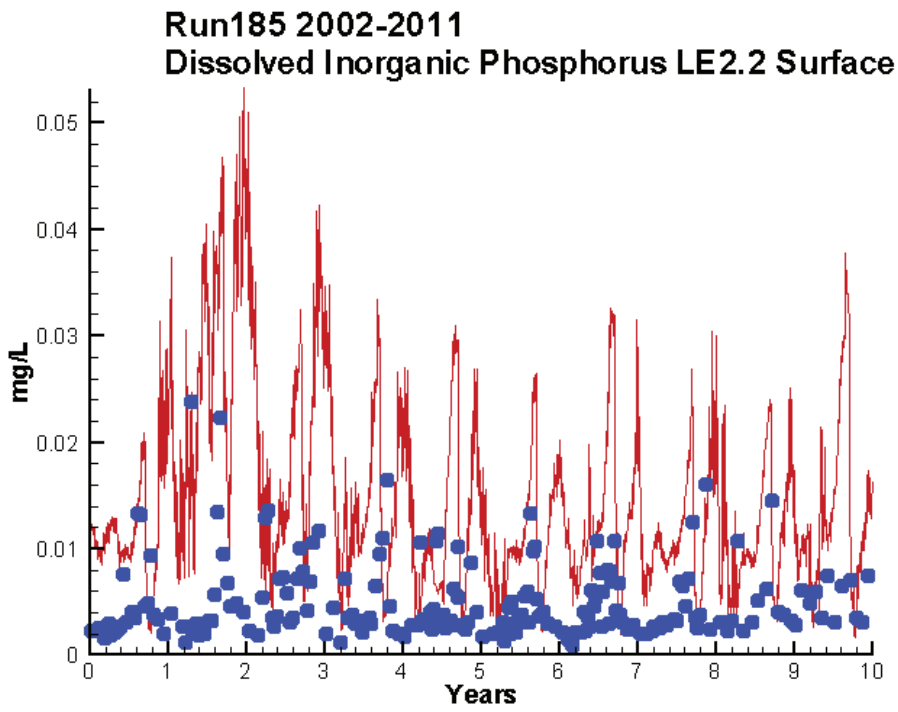
	Mean Difference	Absolute Mean Difference
KE	-1.4963	1.5698
TSS	-28.1208	30.9684

Station LE2.2

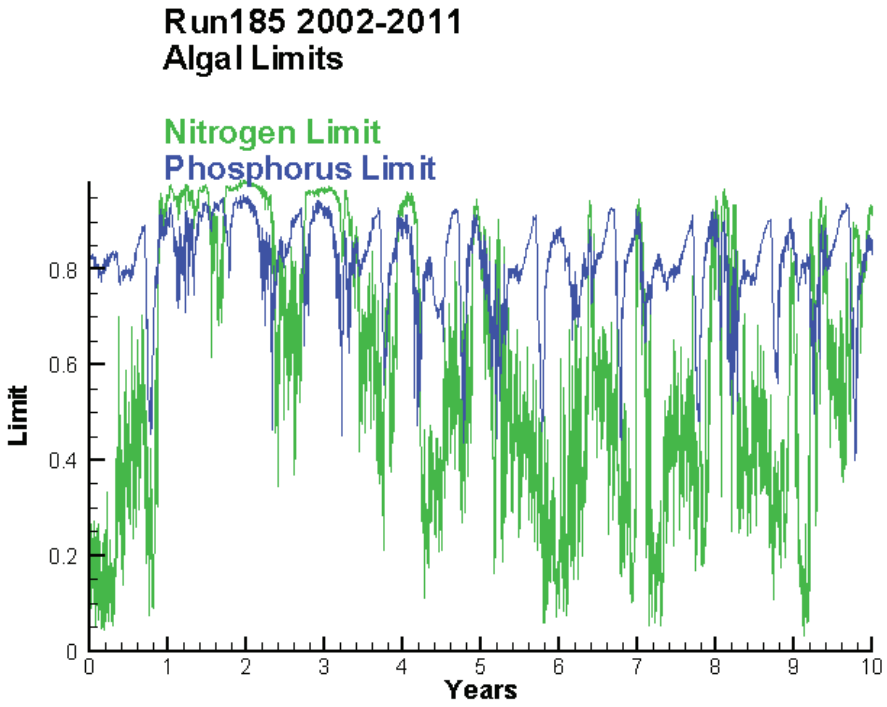


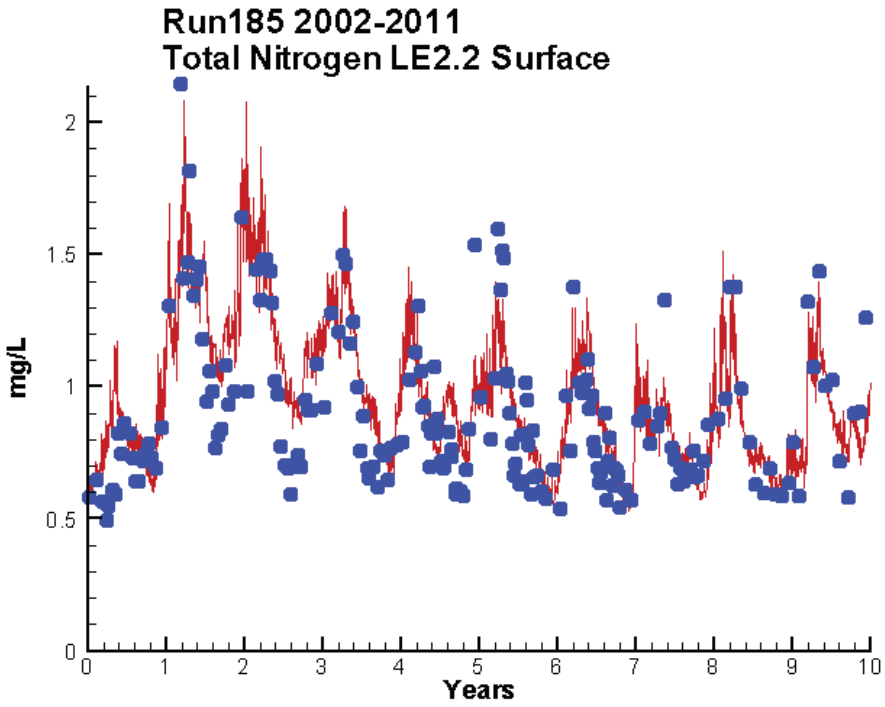


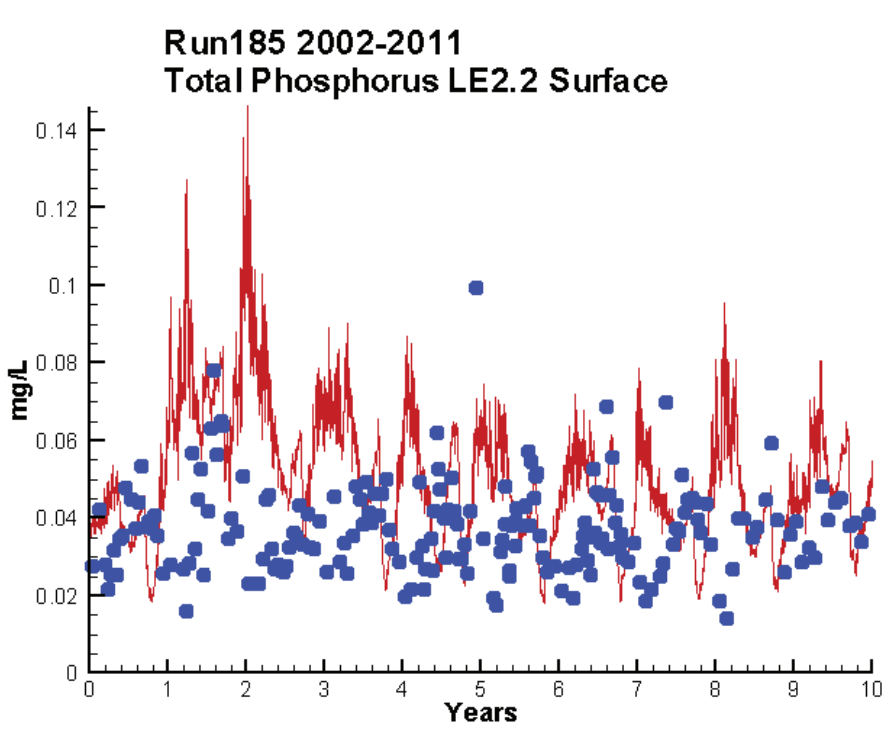




Station LE2.2

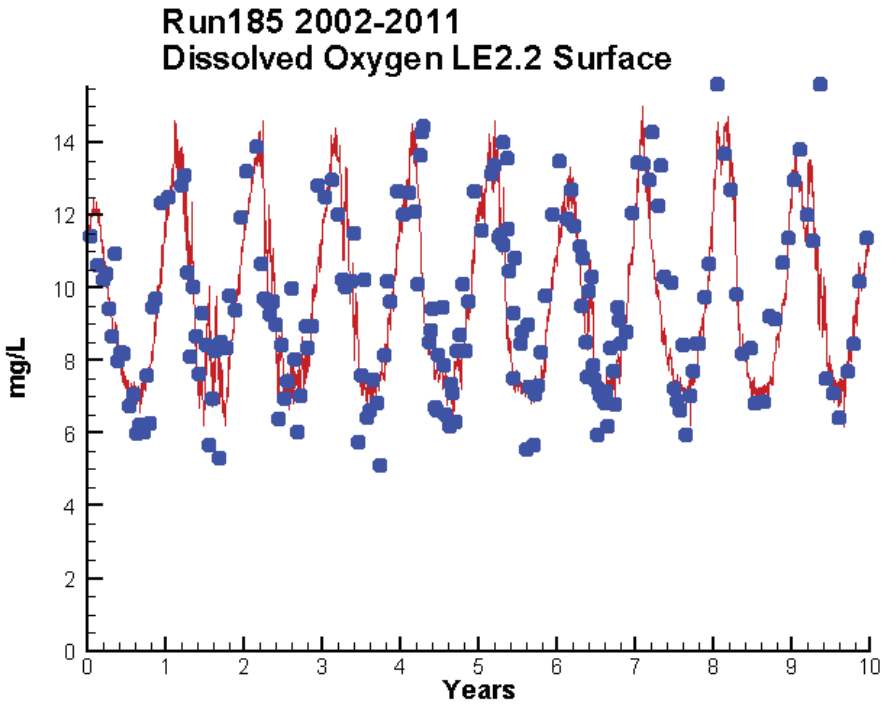


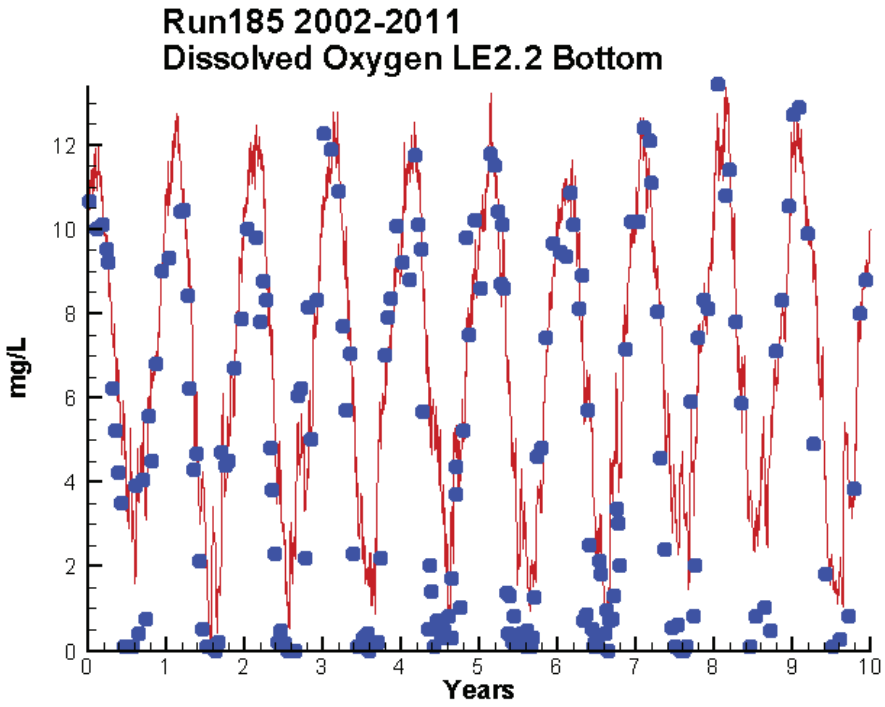


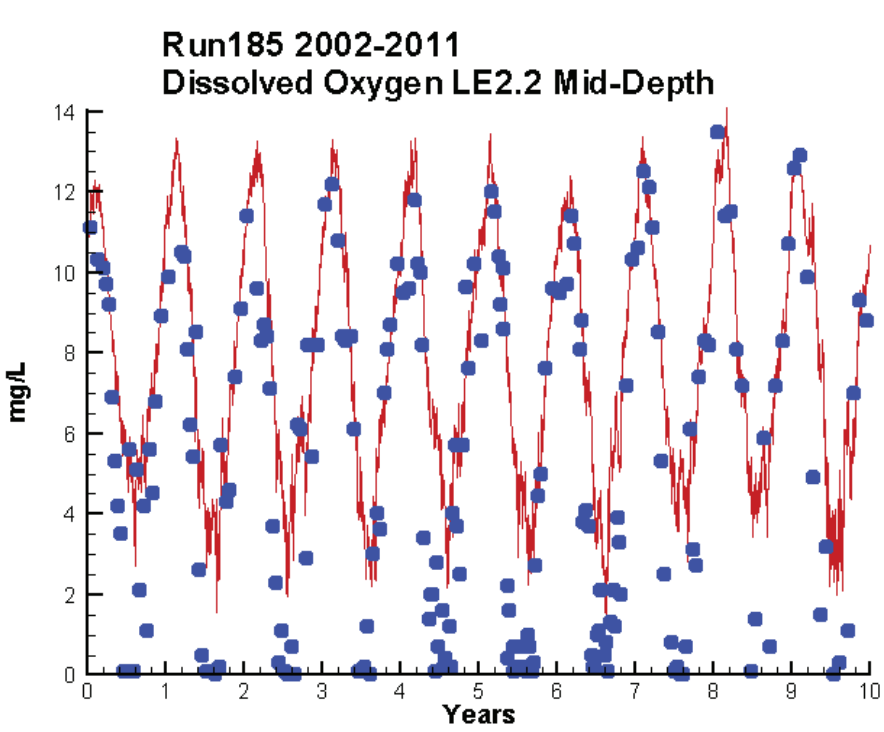


	Mean Difference	Absolute Mean Difference
Chl	-0.9632	8.2425
DIN	-0.0847	0.1468
KE	0.0587	0.3312
DIP	0.0091	0.0098
TP	0.0117	0.0183
TN	0.0667	0.1497

Station LE2.2

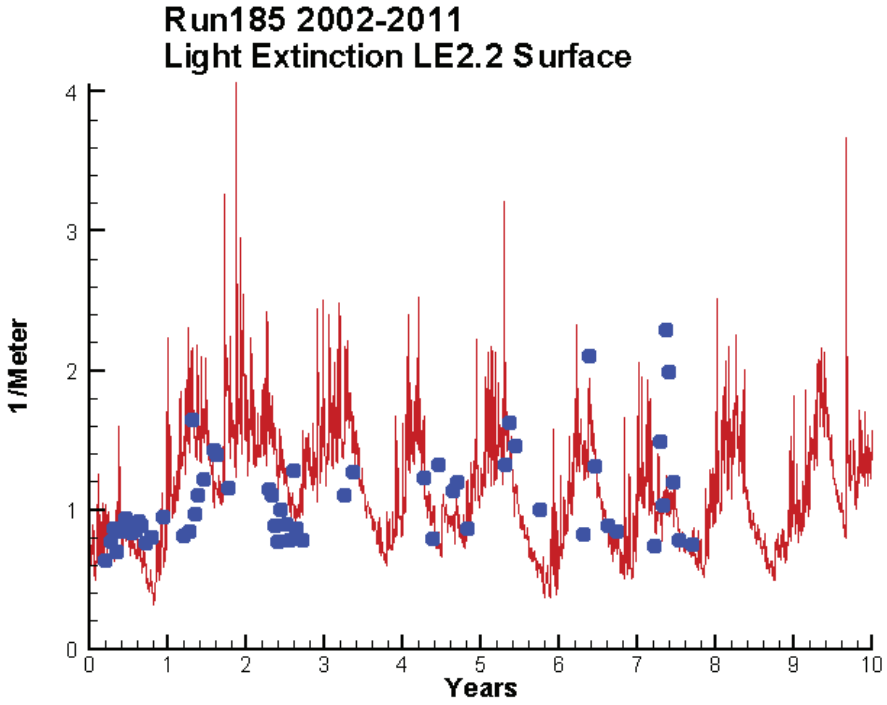


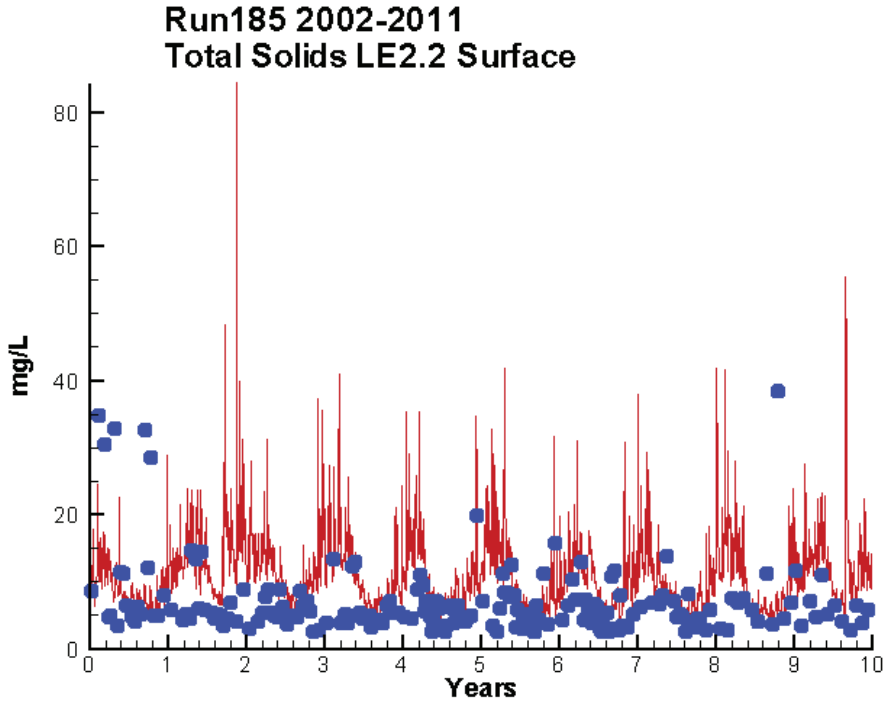


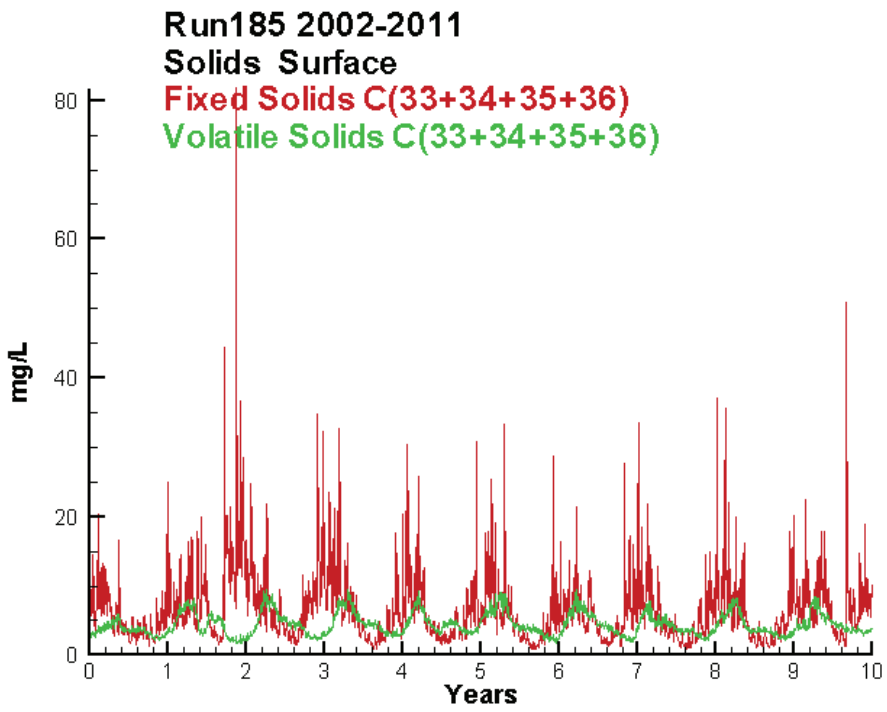


	Mean Difference	Absolute Mean Difference
Top DO	-0.1624	1.0536
Mid DO	2.1136	2.2666
Bot DO	1.5407	1.8353

Station LE2.2

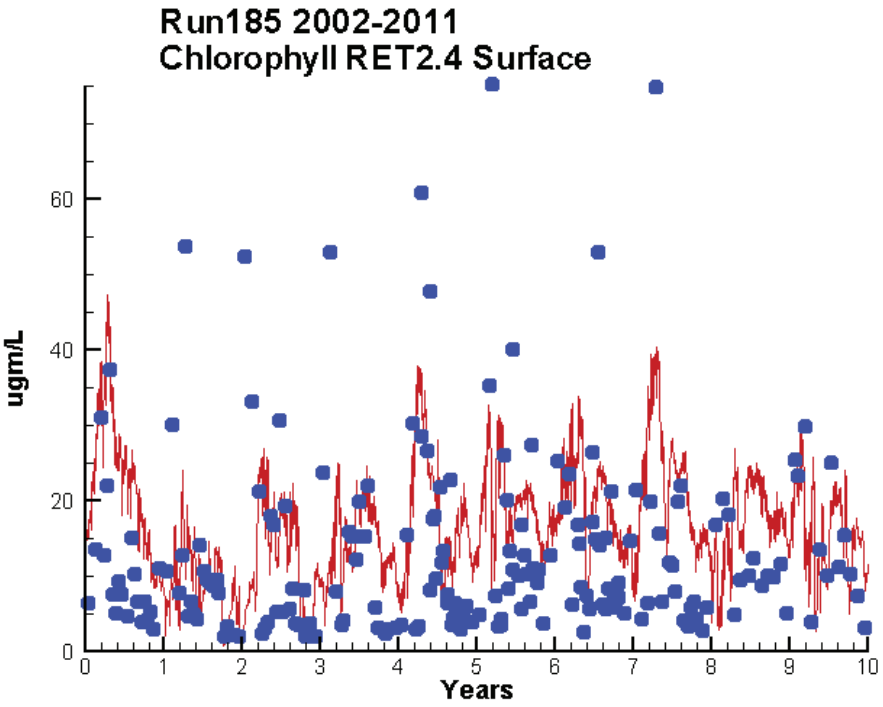


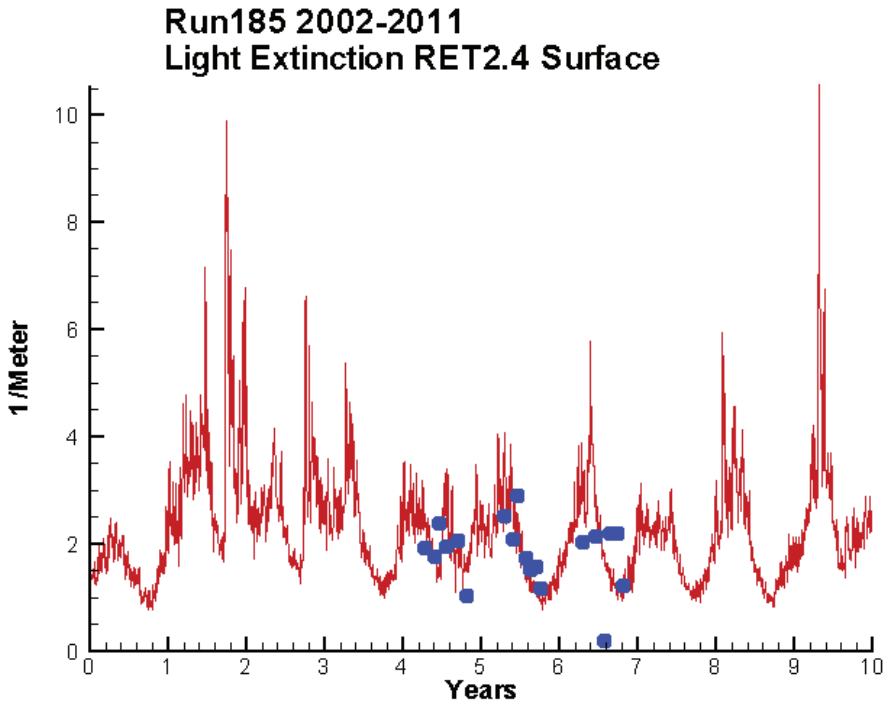


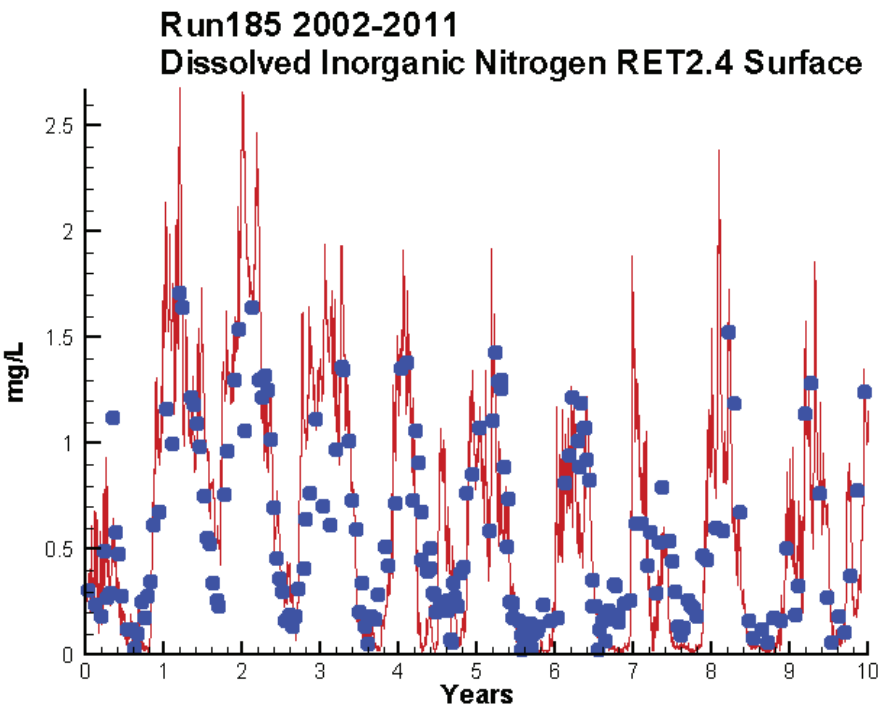


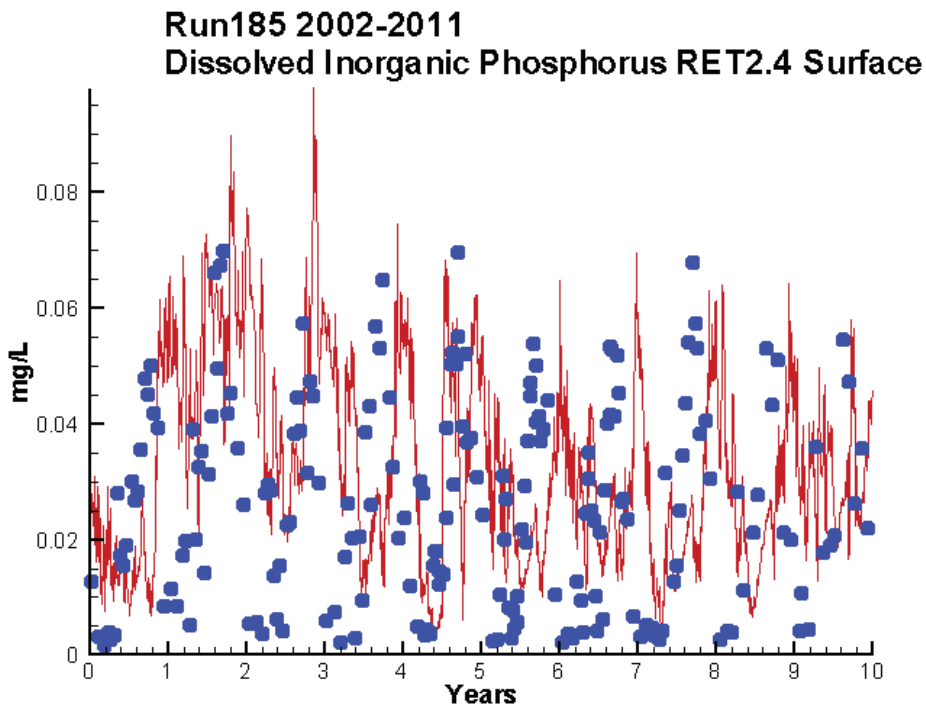
	Mean Difference	Absolute Mean Difference
KE	0.0587	0.3312
TSS	3.0495	5.1696

Station RET2.4

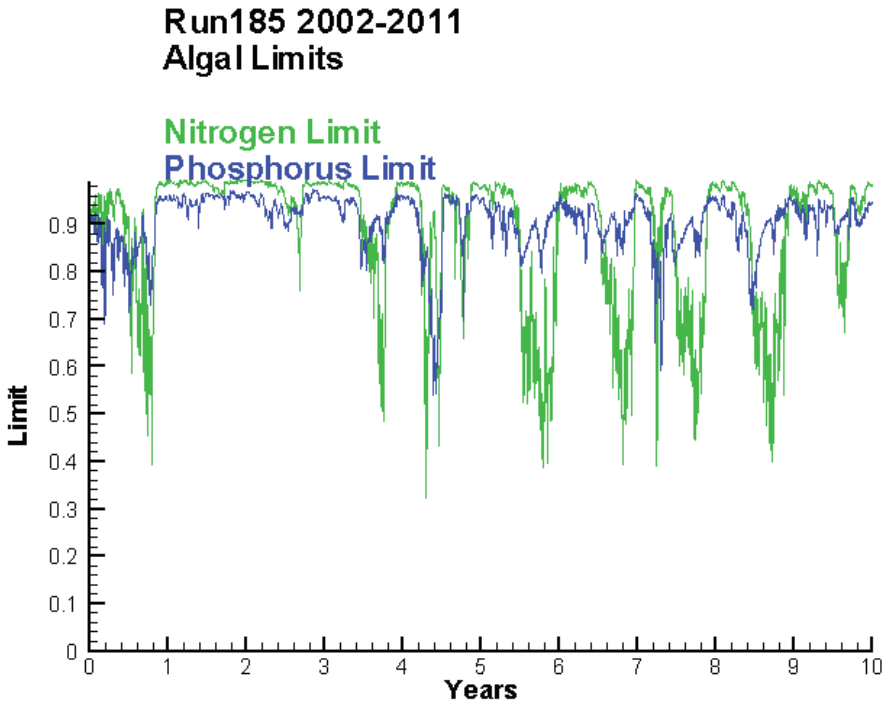


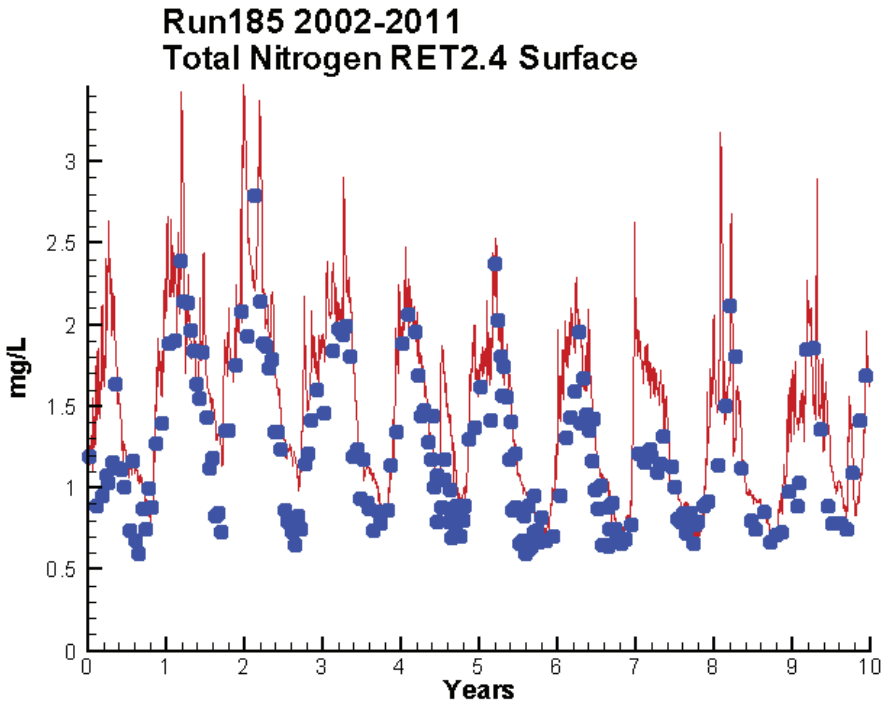


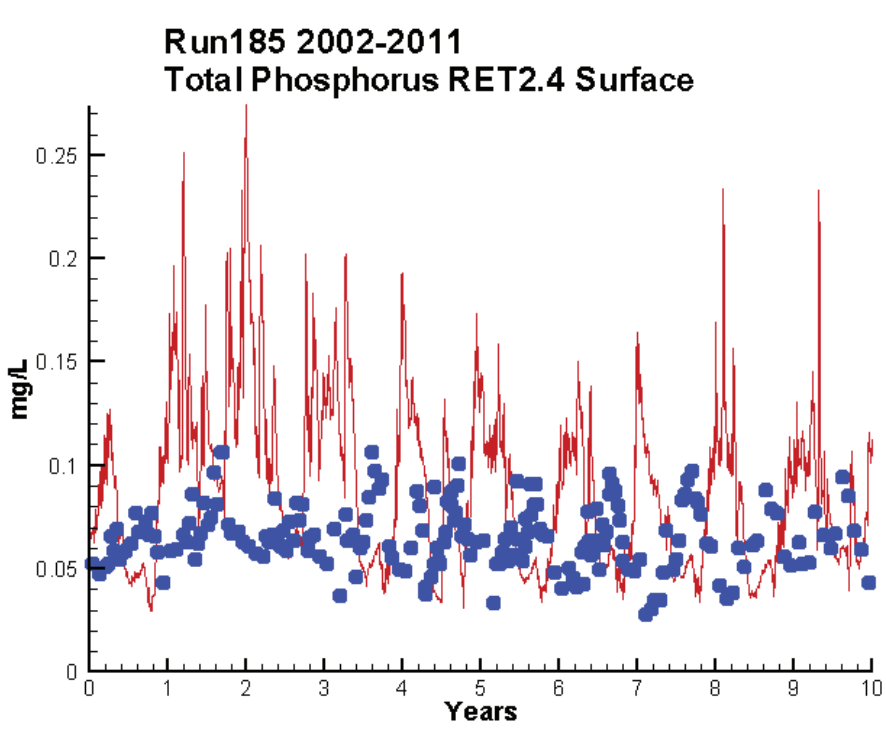




Station RET2.4

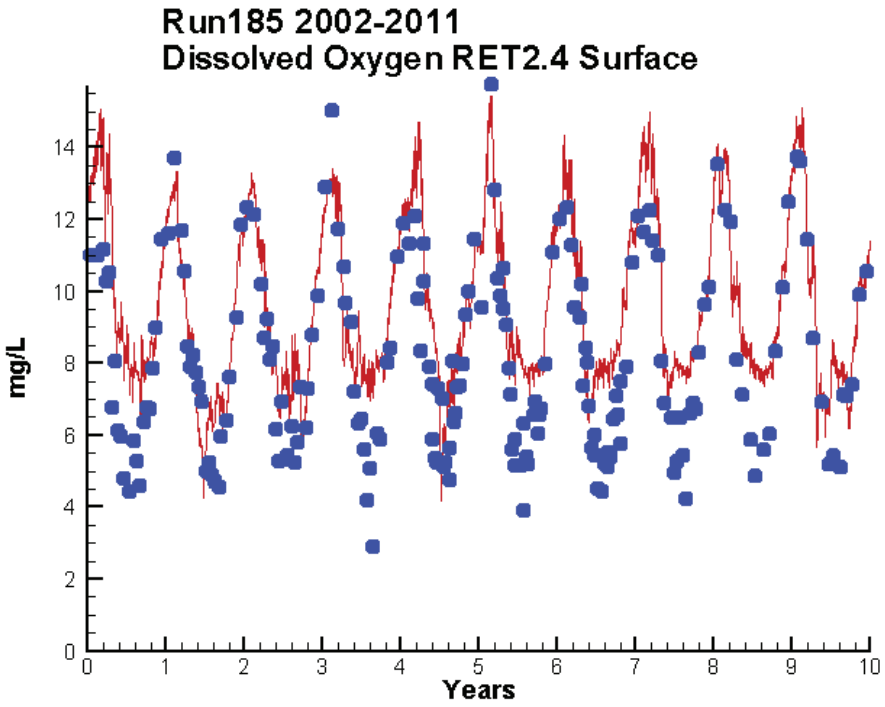


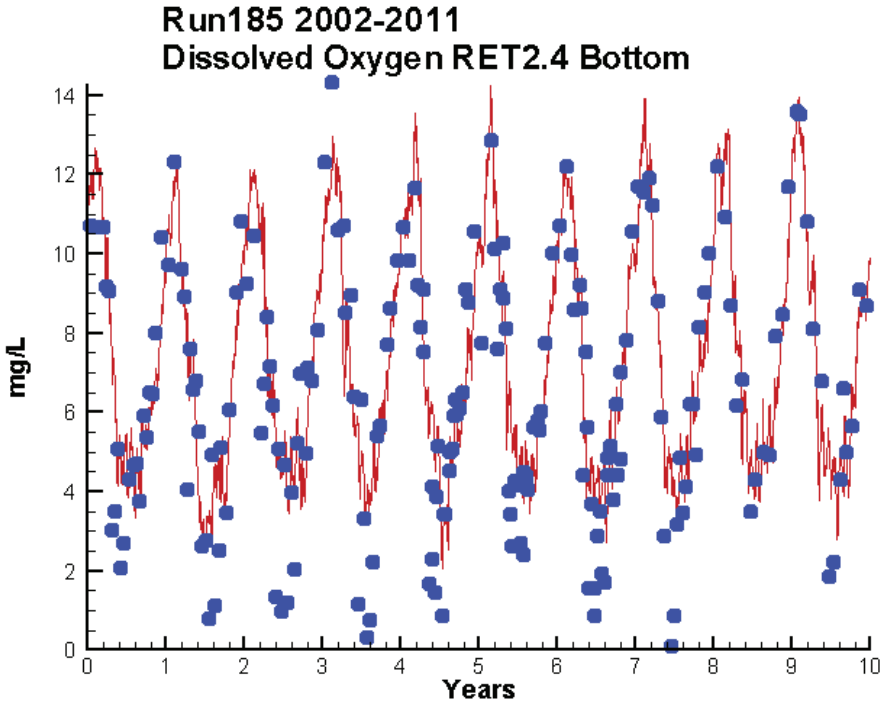




	Mean Difference	Absolute Mean Difference
Chl	4.7926	10.6241
DIN	-0.0015	0.2418
KE	0.0979	0.5984
DIP	0.0036	0.0199
TP	0.0170	0.0370
TN	0.2525	0.2882

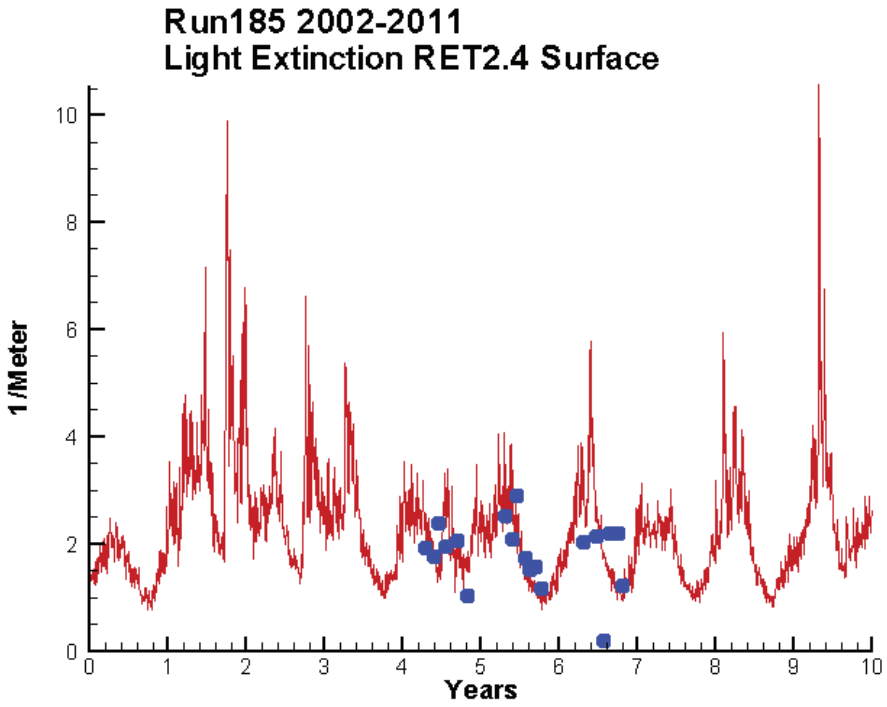
Station RET2.4

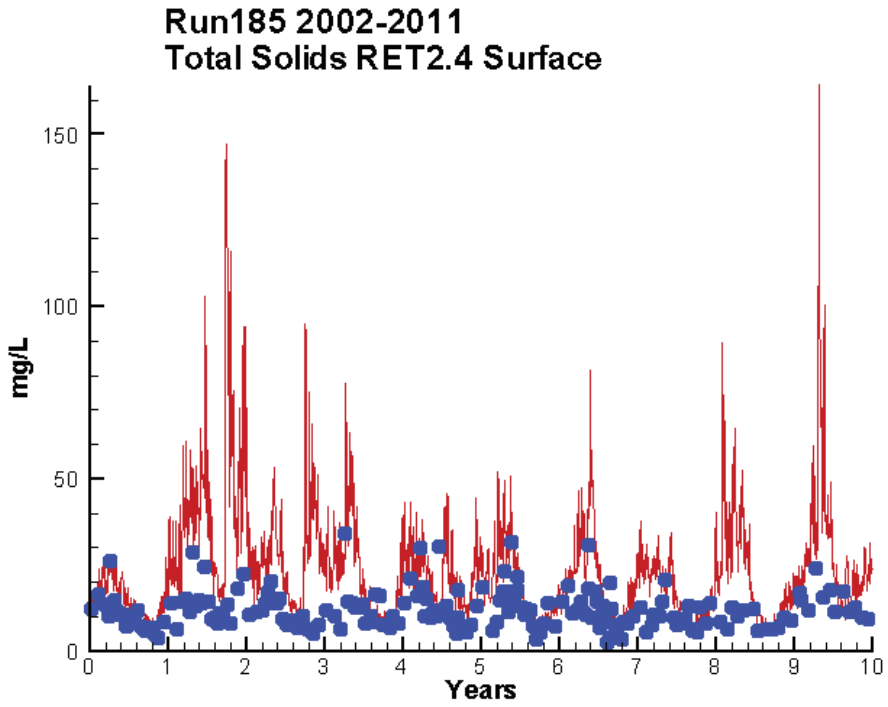


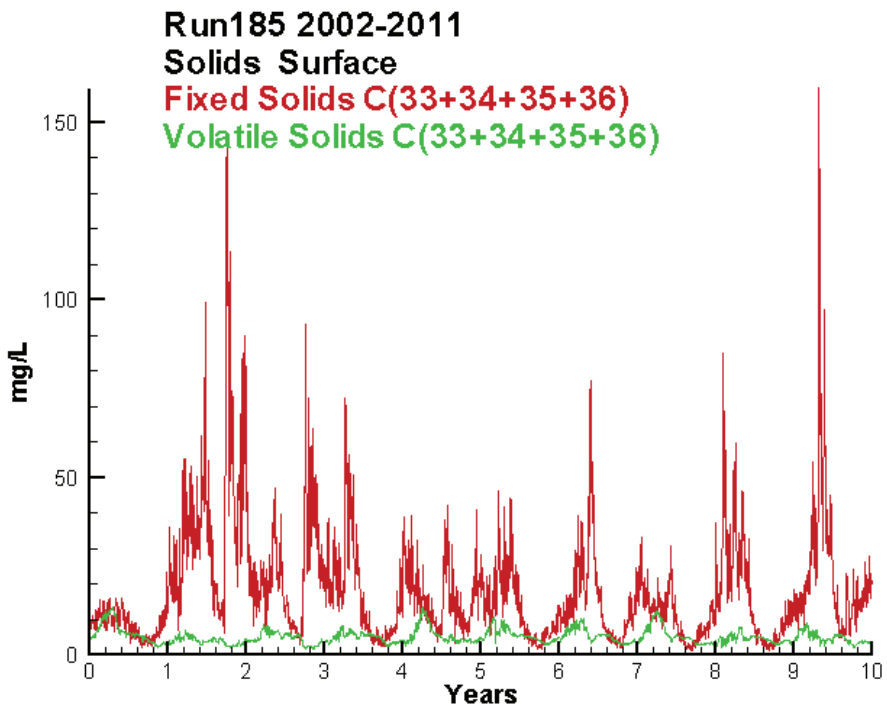


	Mean Difference	Absolute Mean Difference
Top DO	1.2716	1.5008
Bot DO	0.5602	1.2794

Station RET2.4

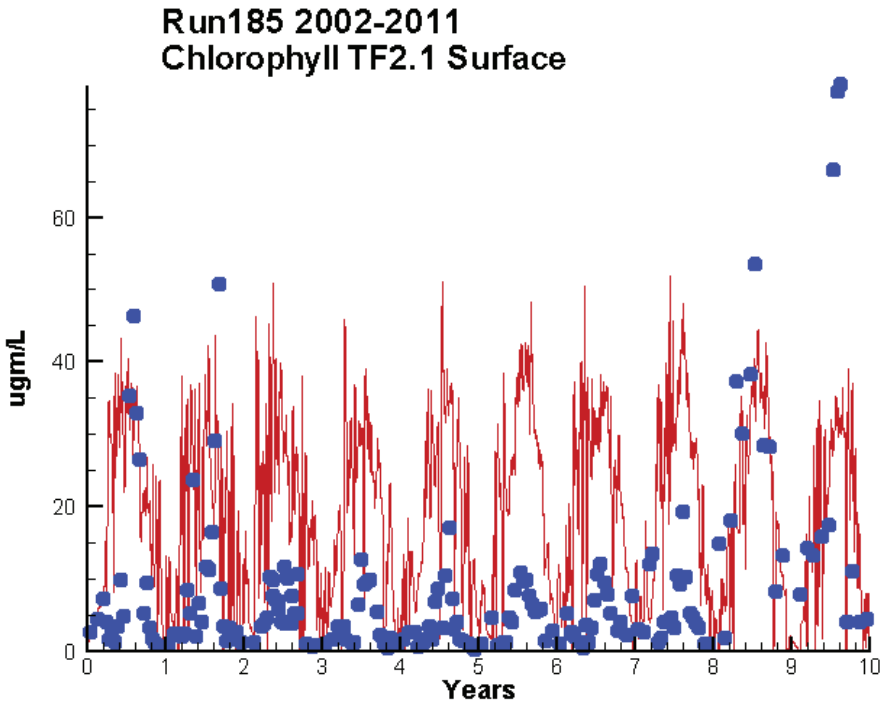


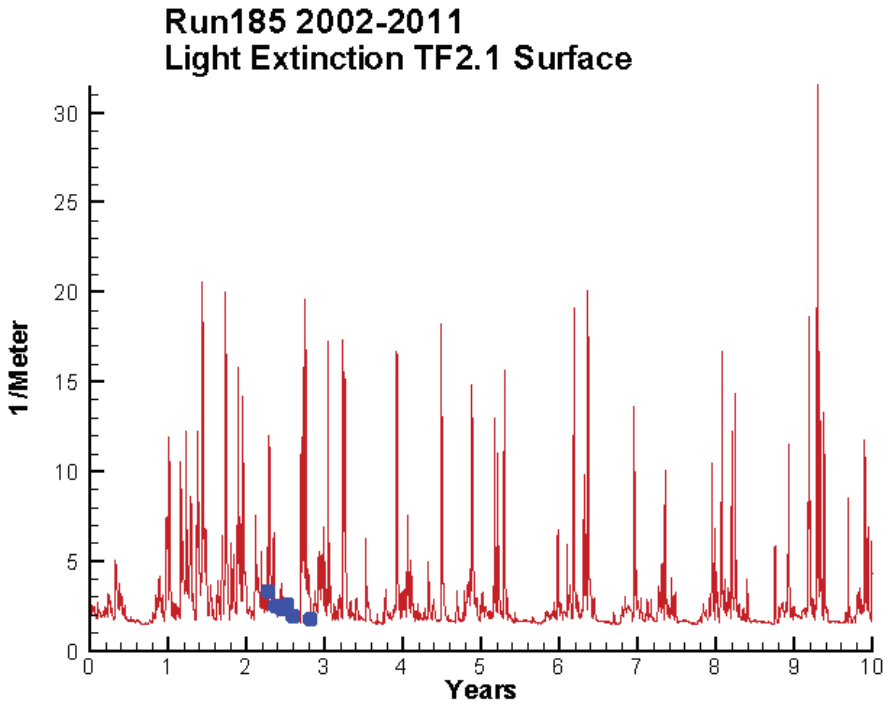


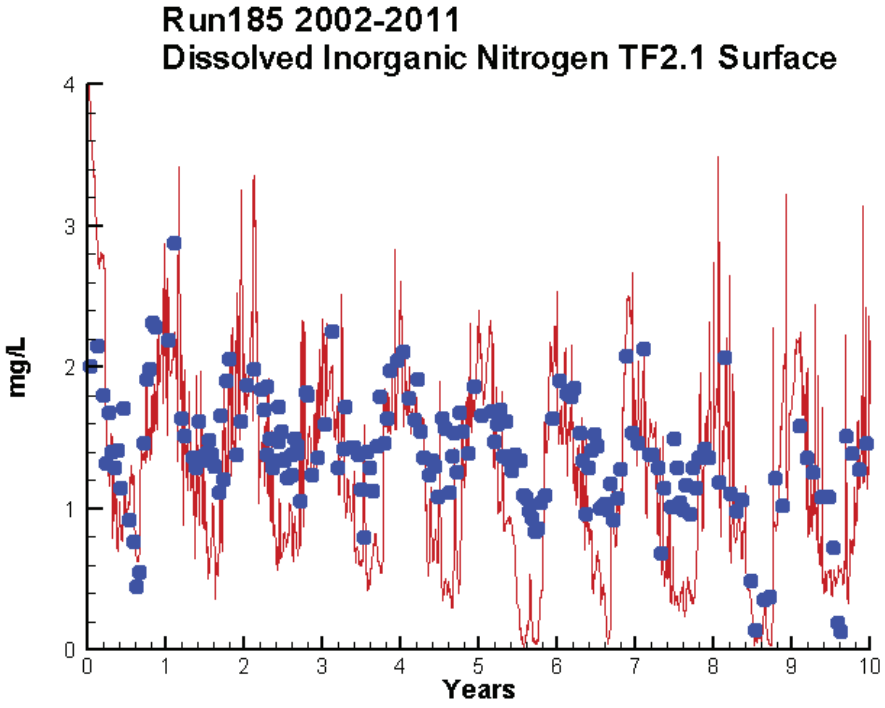


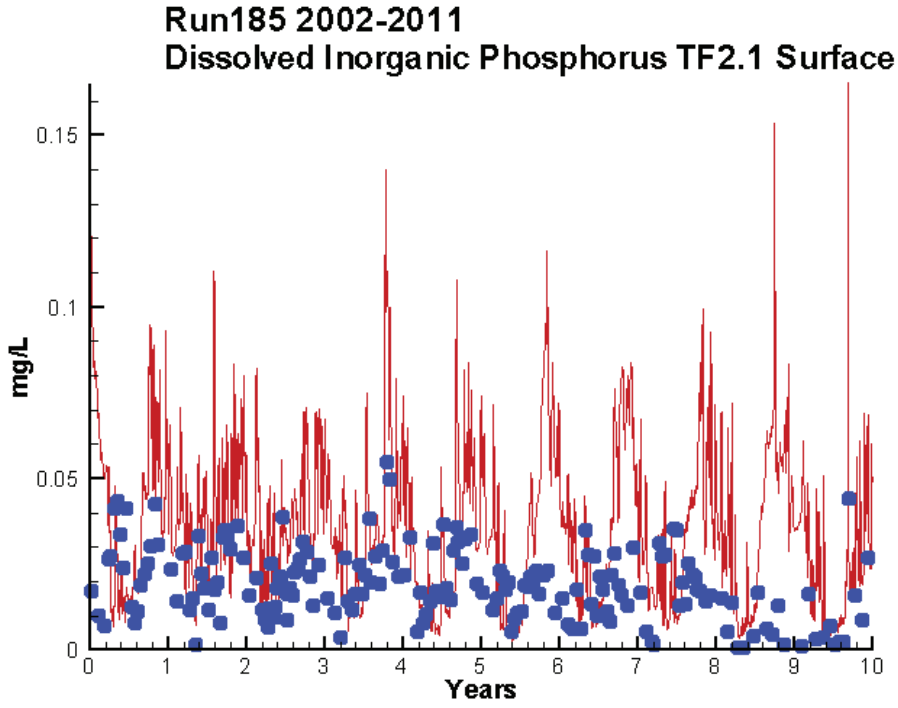
	Mean Difference	Absolute Mean Difference
KE	0.0979	0.5984
TSS	10.5533	11.3807

Station TF2.1



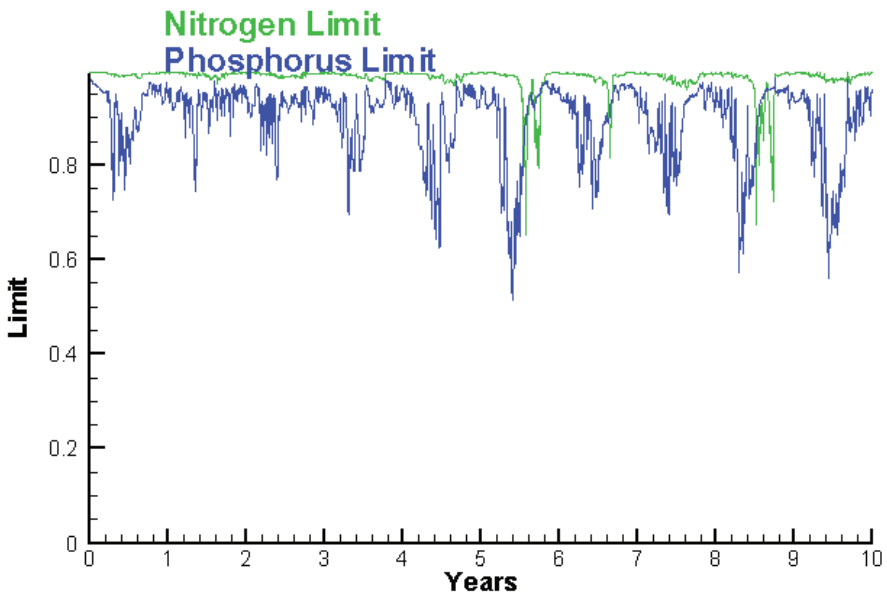




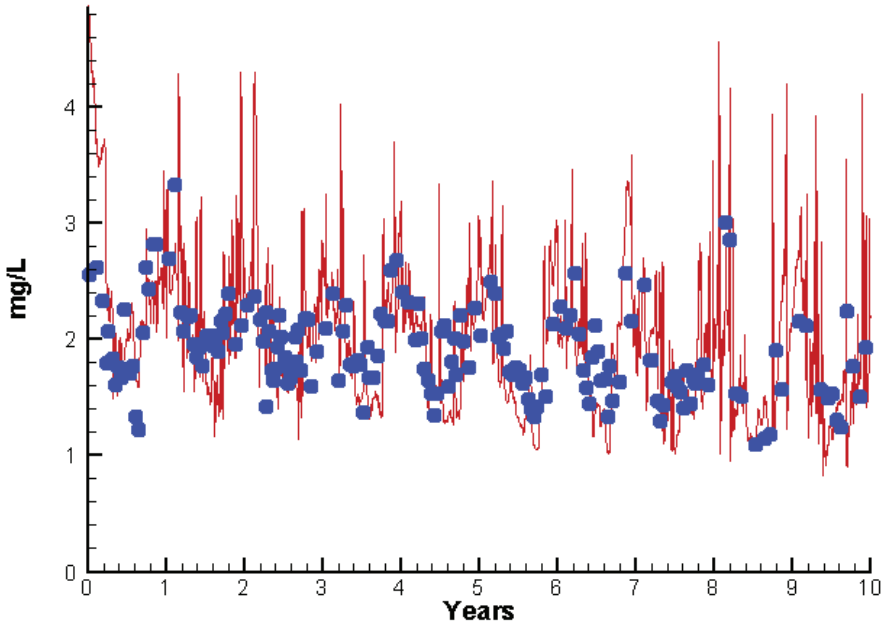


Station TF2.1

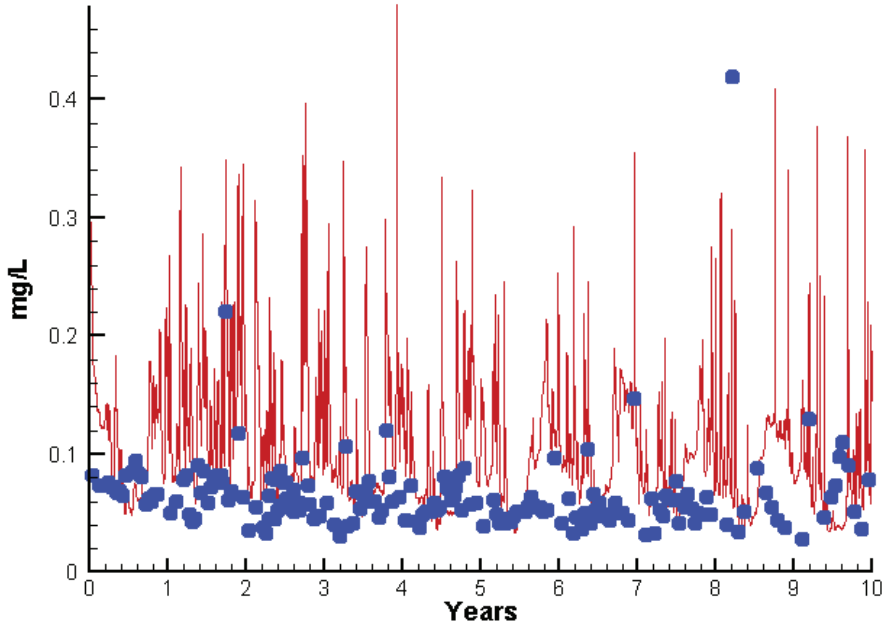
Run185 2002-2011
Algal Limits



Run185 2002-2011
Total Nitrogen TF2.1 Surface

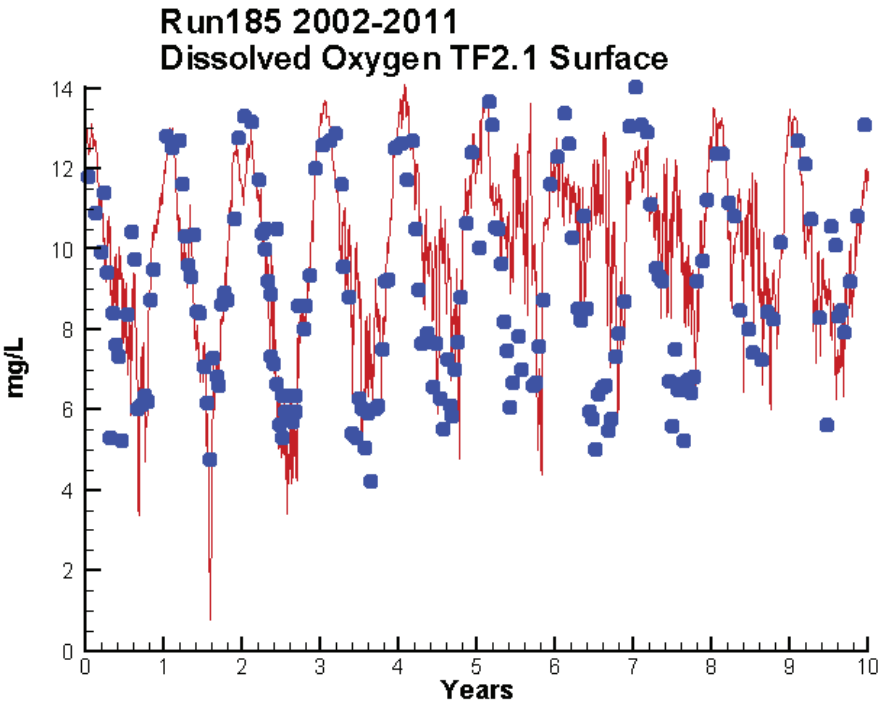


Run185 2002-2011
Total Phosphorus TF2.1 Surface



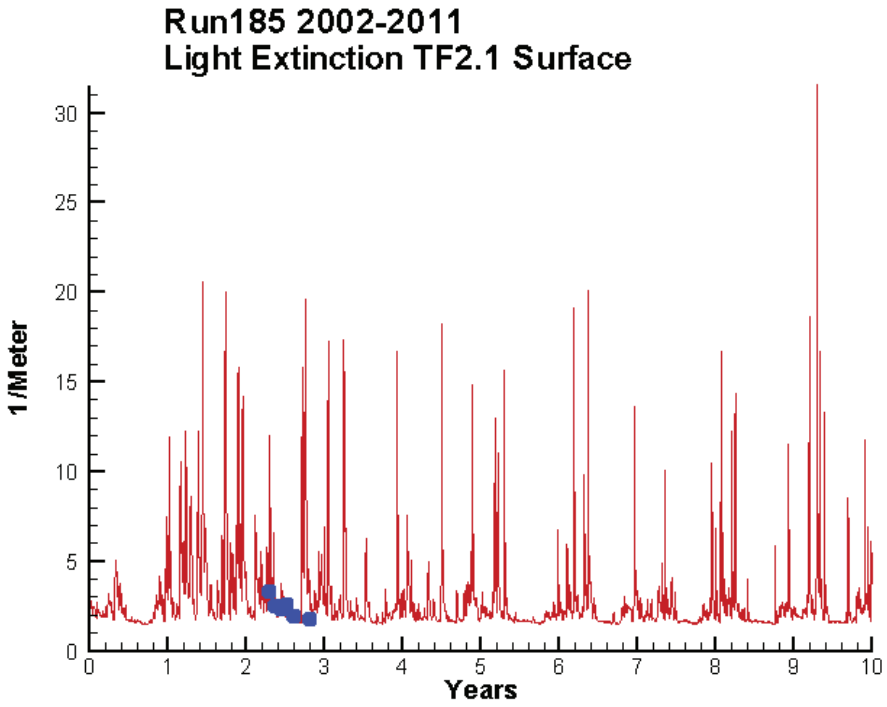
	Mean Difference	Absolute Mean Difference
Chl	13.5660	16.8913
DIN	-0.2806	0.5062
KE	1.6425	1.9452
DIP	0.0154	0.0204
TP	0.0422	0.0516
TN	0.0074	0.3968

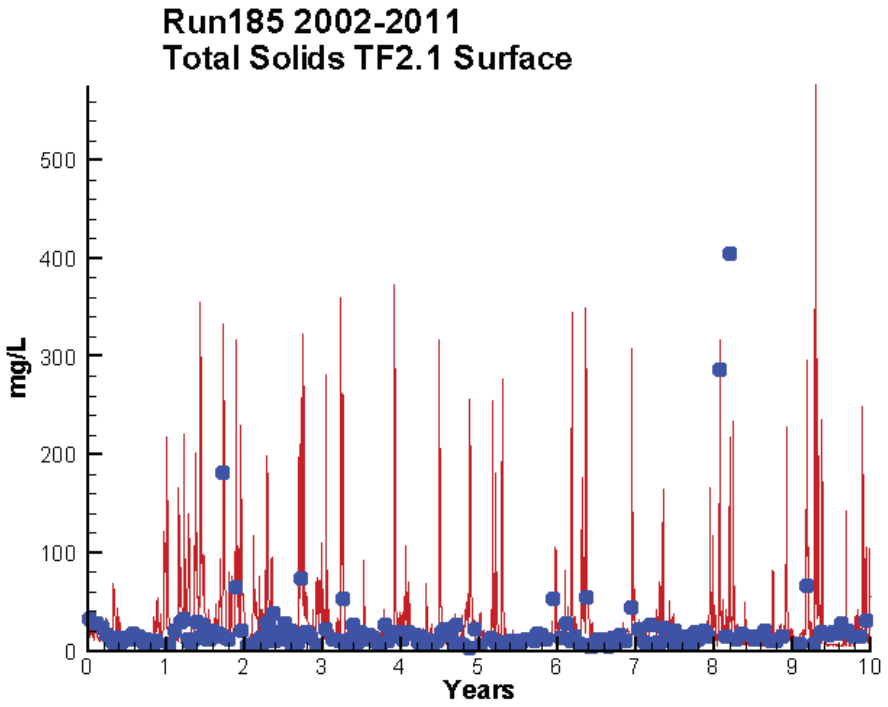
Station TF2.1

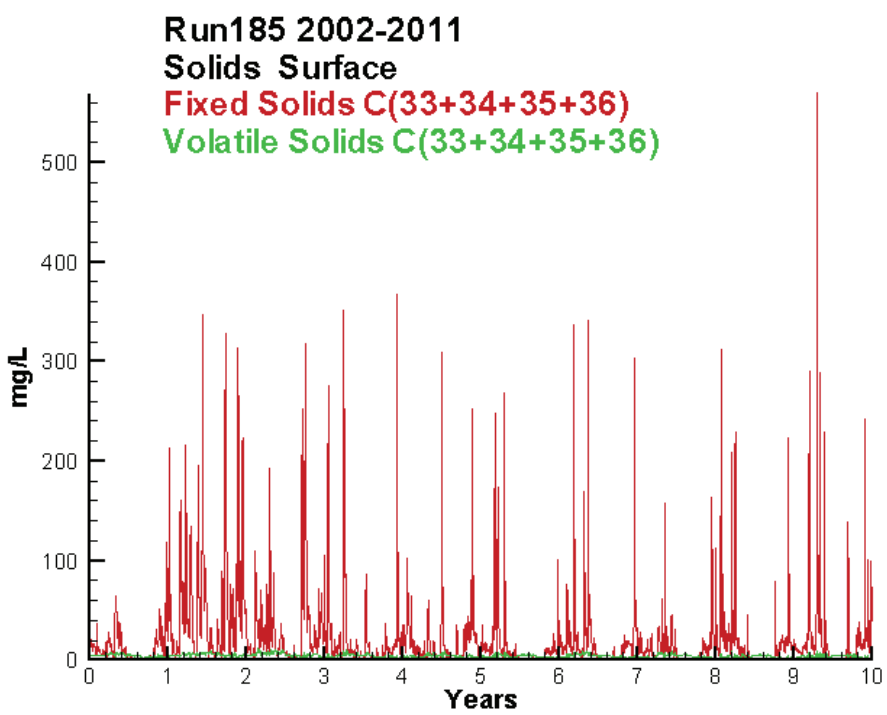


	Mean Difference	Absolute Mean Difference
Top DO	0.7524	1.6306

Station TF2.1



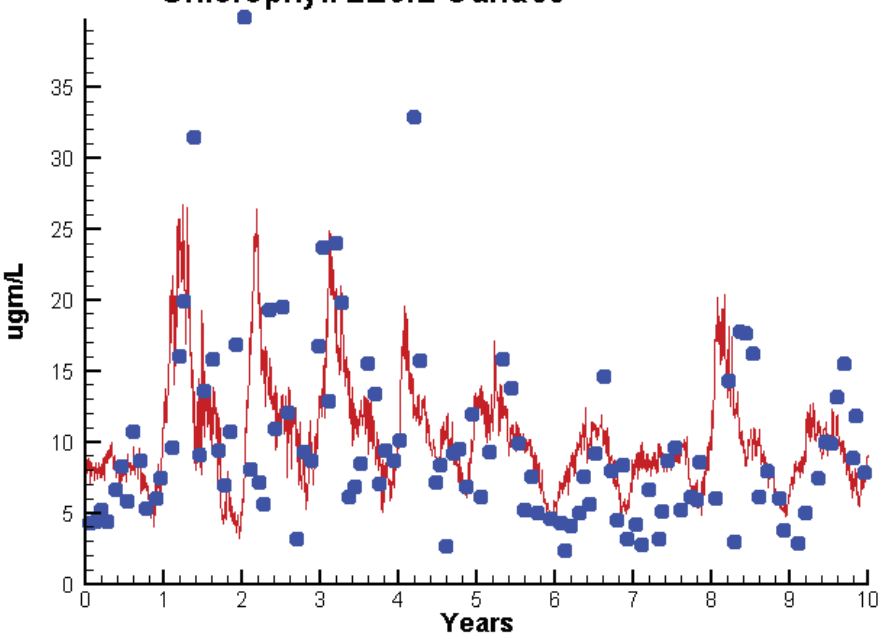




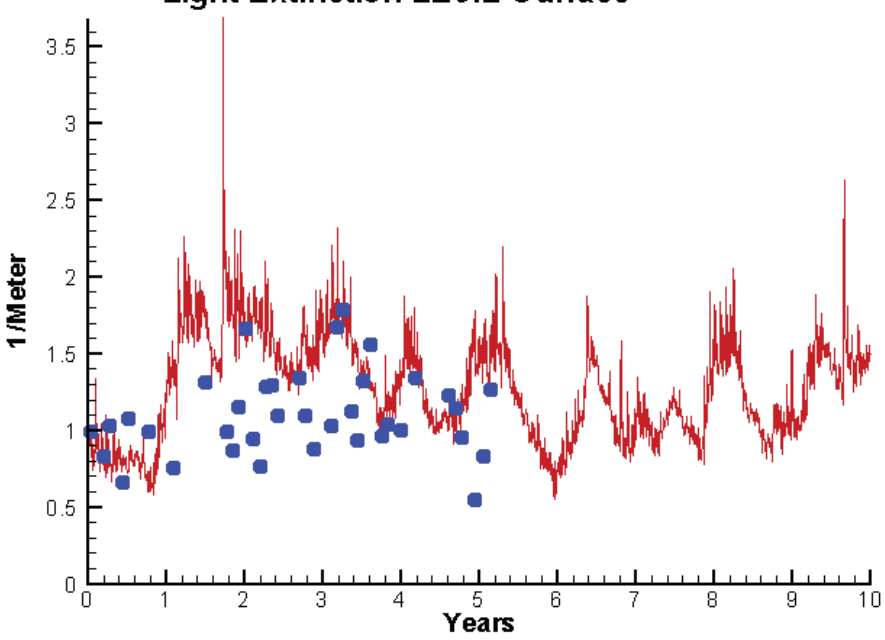
	Mean Difference	Absolute Mean Difference
KE	1.6425	1.9452
TSS	6.9819	18.7226

Station LE3.2

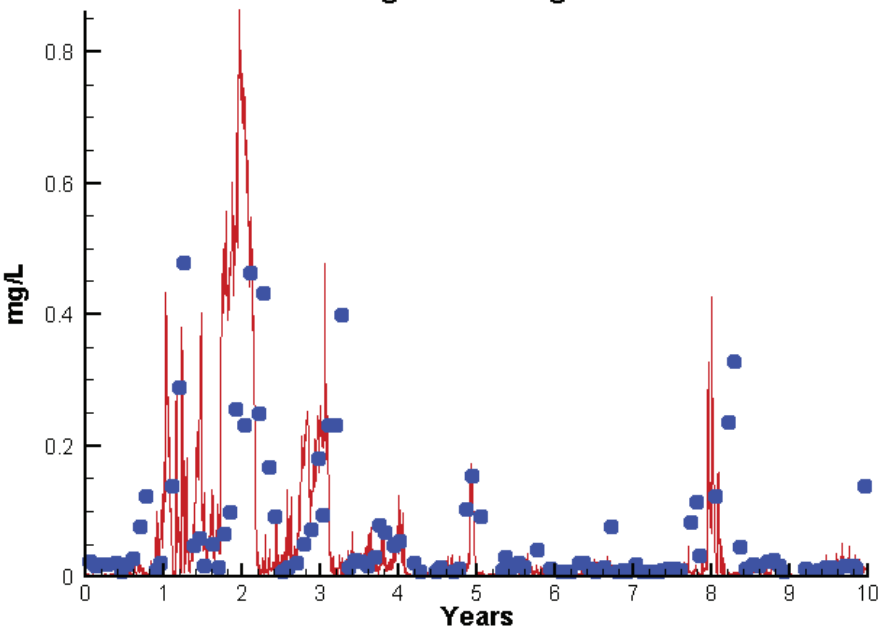
Run185 2002-2011
Chlorophyll LE3.2 Surface



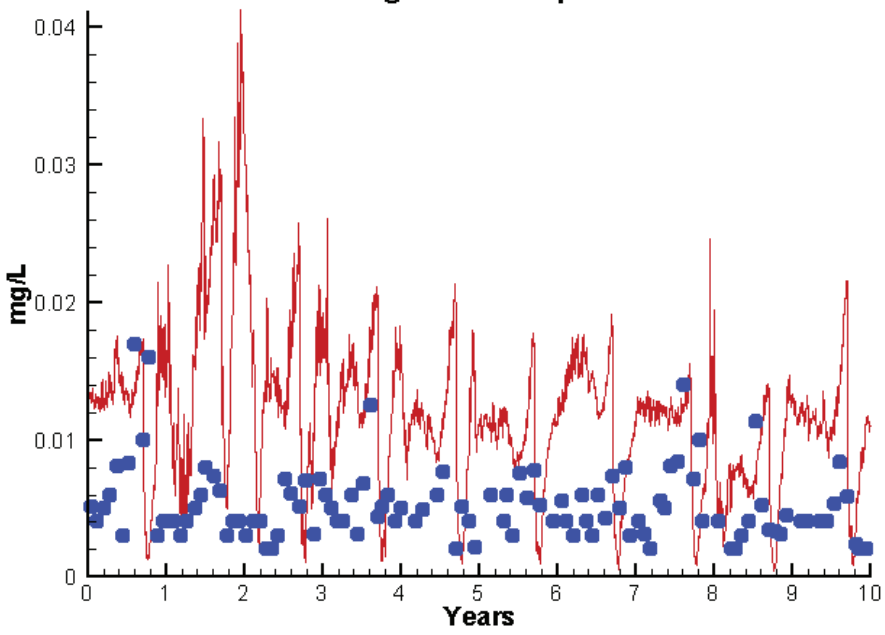
Run185 2002-2011
Light Extinction LE3.2 Surface



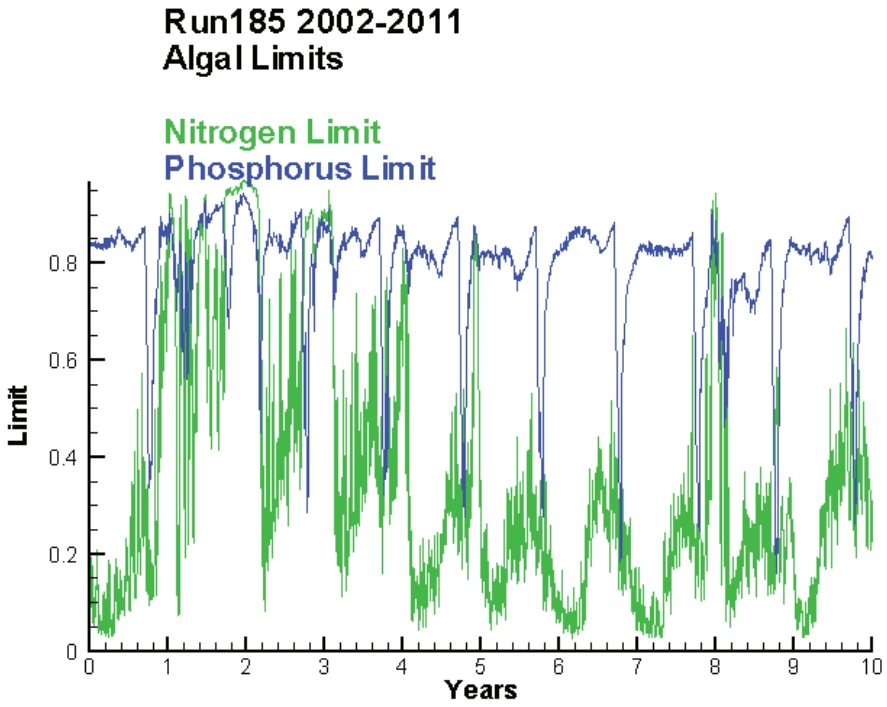
Run185 2002-2011
Dissolved Inorganic Nitrogen LE3.2 Surface

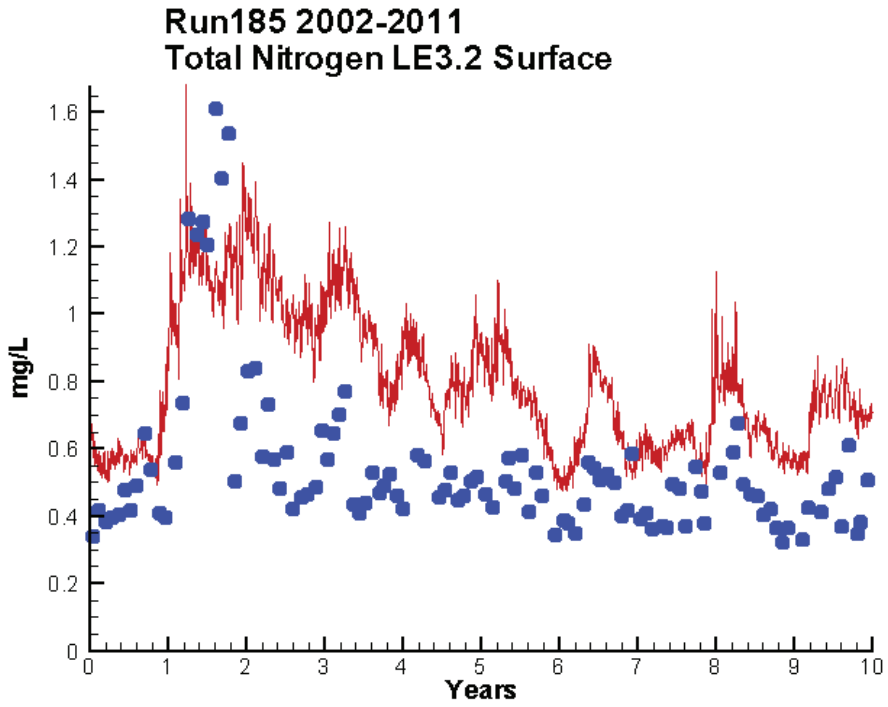


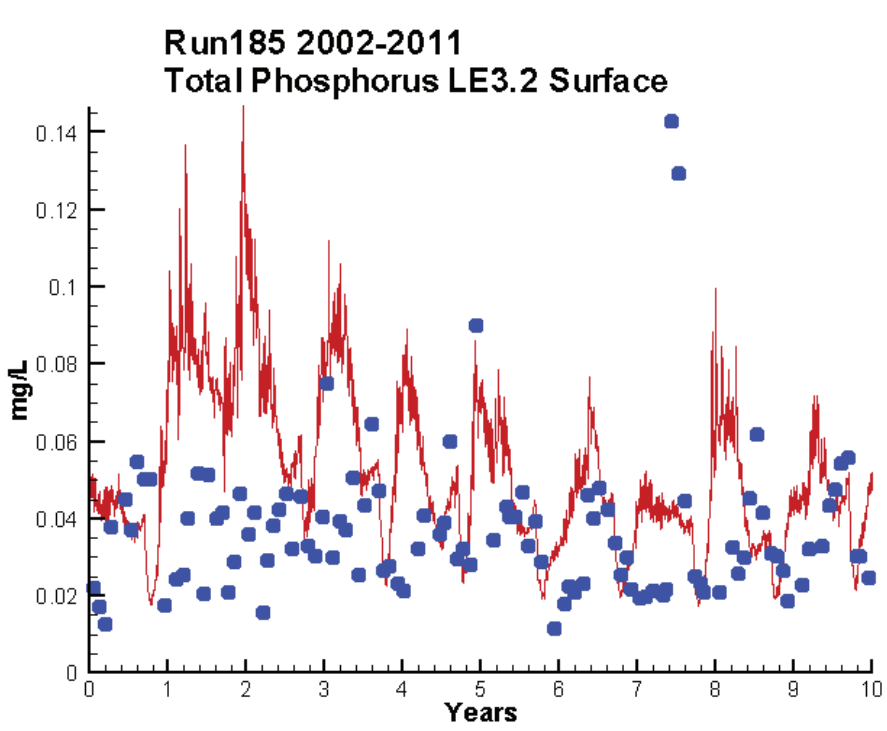
Run185 2002-2011
Dissolved Inorganic Phosphorus LE3.2 Surface



Station LE3.2

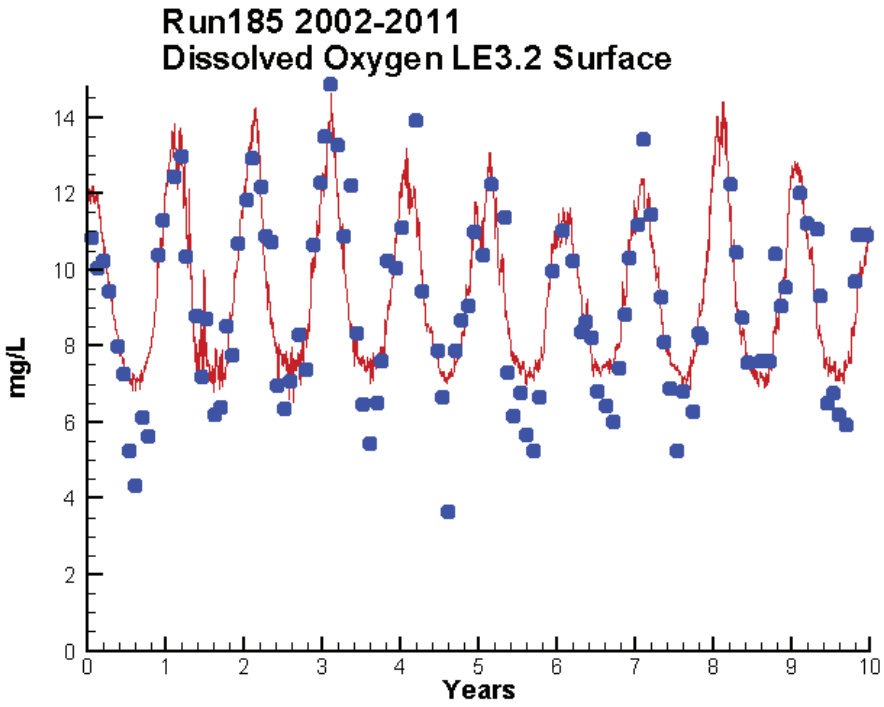


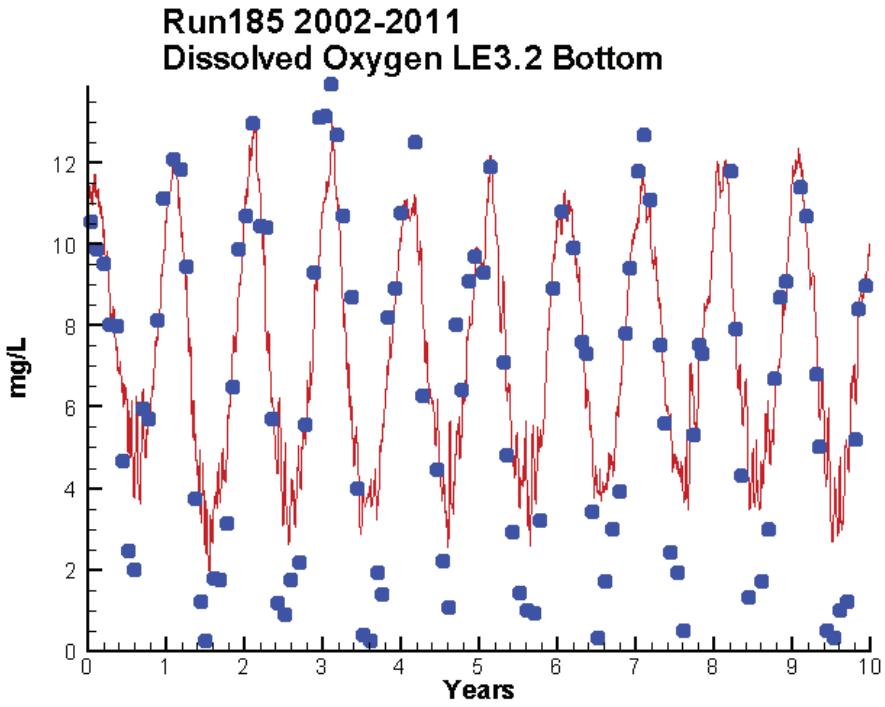


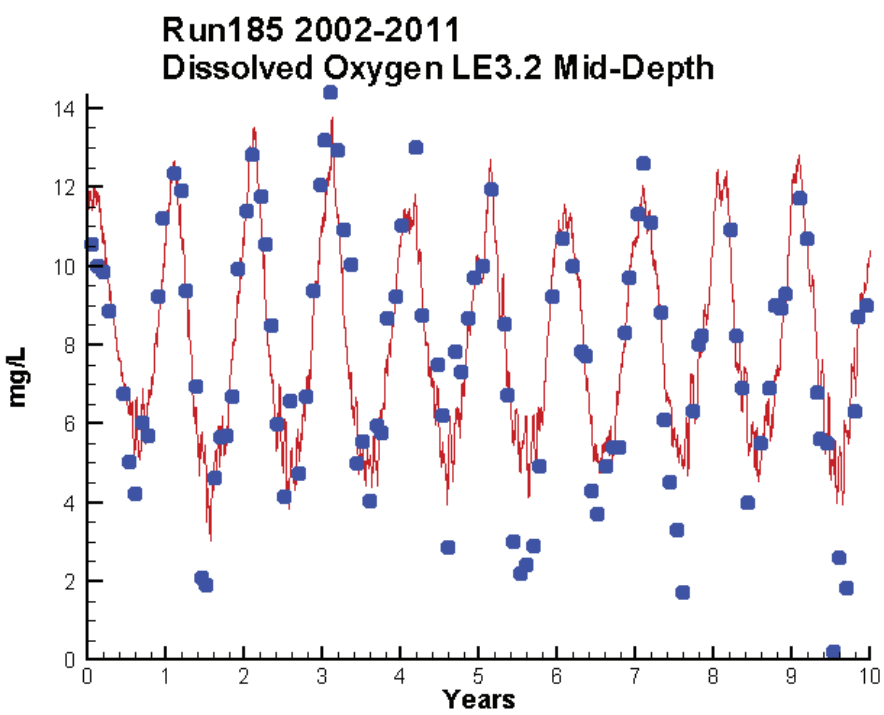


	Mean Difference	Absolute Mean Difference
Chl	0.4101	4.2434
DIN	-0.0162	0.0670
KE	0.3002	0.3817
DIP	0.0068	0.0079
TP	0.0147	0.0226
TN	0.2622	0.2890

Station LE3.2



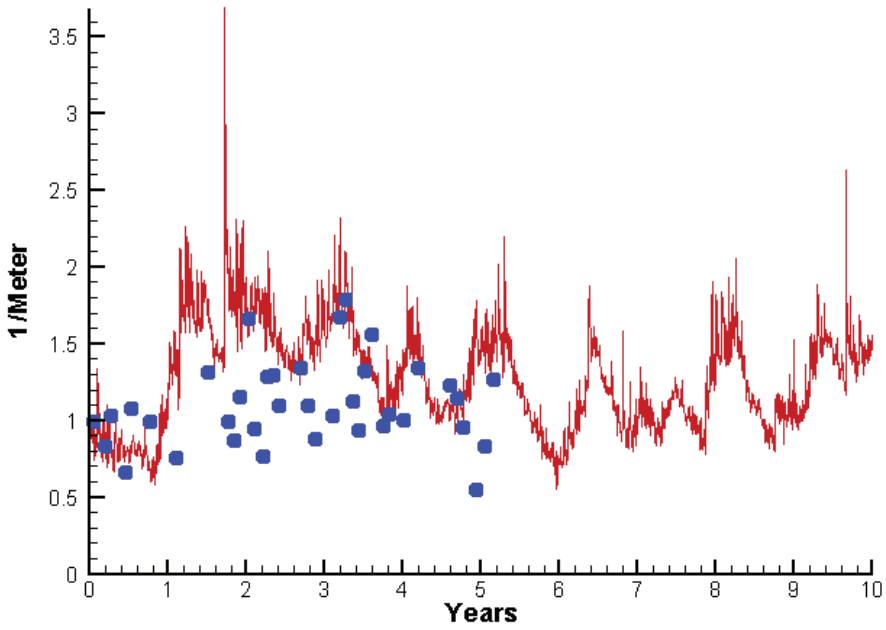




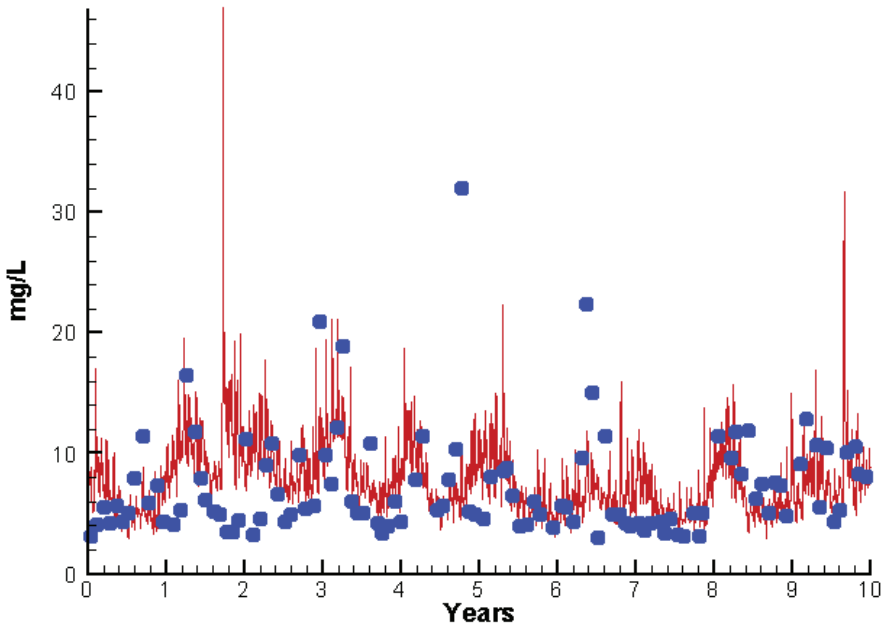
	Mean Difference	Absolute Mean Difference
Top DO	0.2386	0.9366
Mid DO	0.3382	1.0126
Bot DO	0.7831	1.5272

Station LE3.2

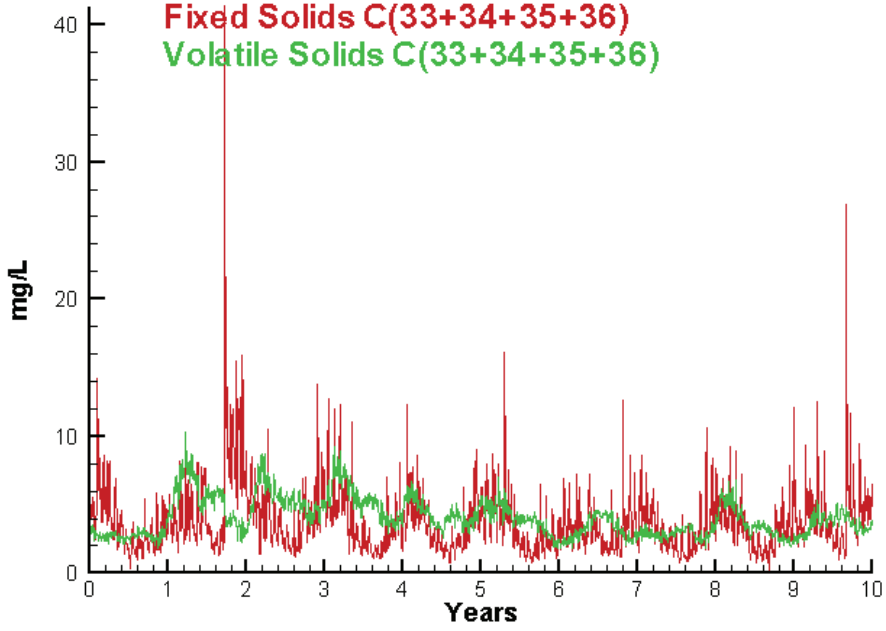
Run185 2002-2011
Light Extinction LE3.2 Surface



Run185 2002-2011
Total Solids LE3.2 Surface

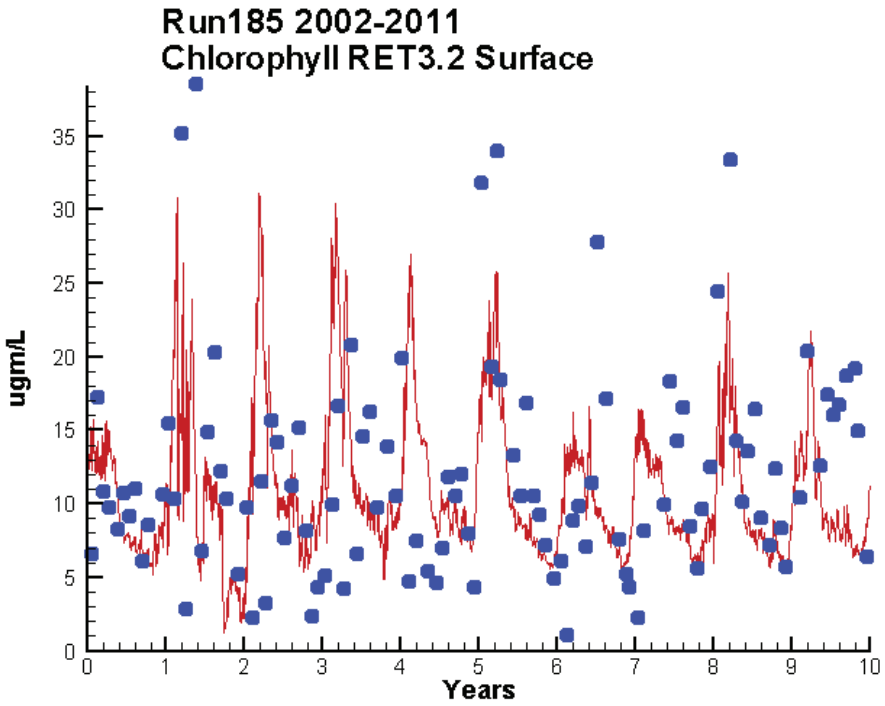


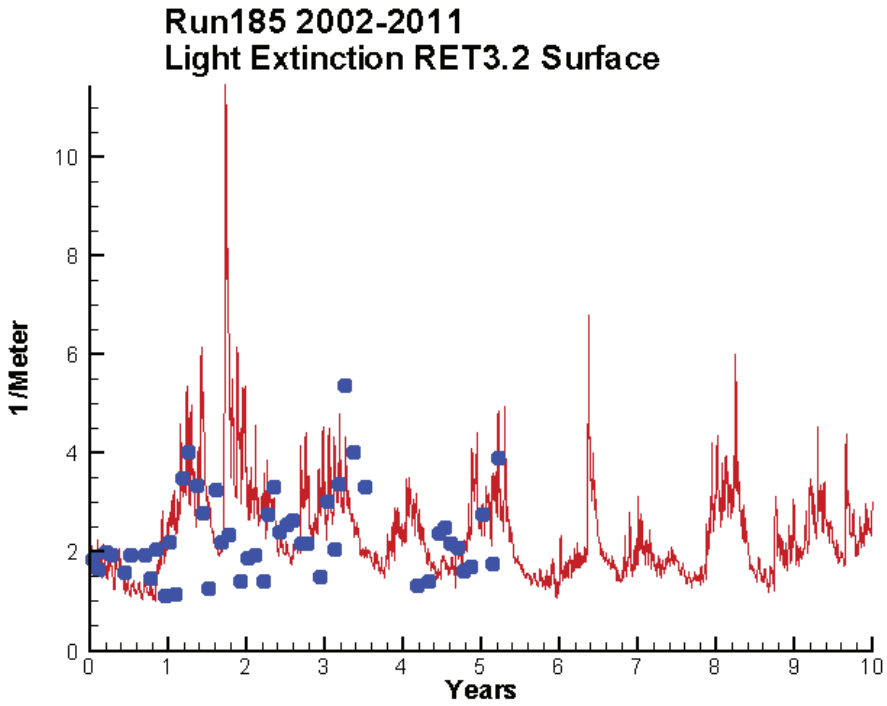
Run185 2002-2011
Solids Surface
Fixed Solids C(33+34+35+36)
Volatile Solids C(33+34+35+36)

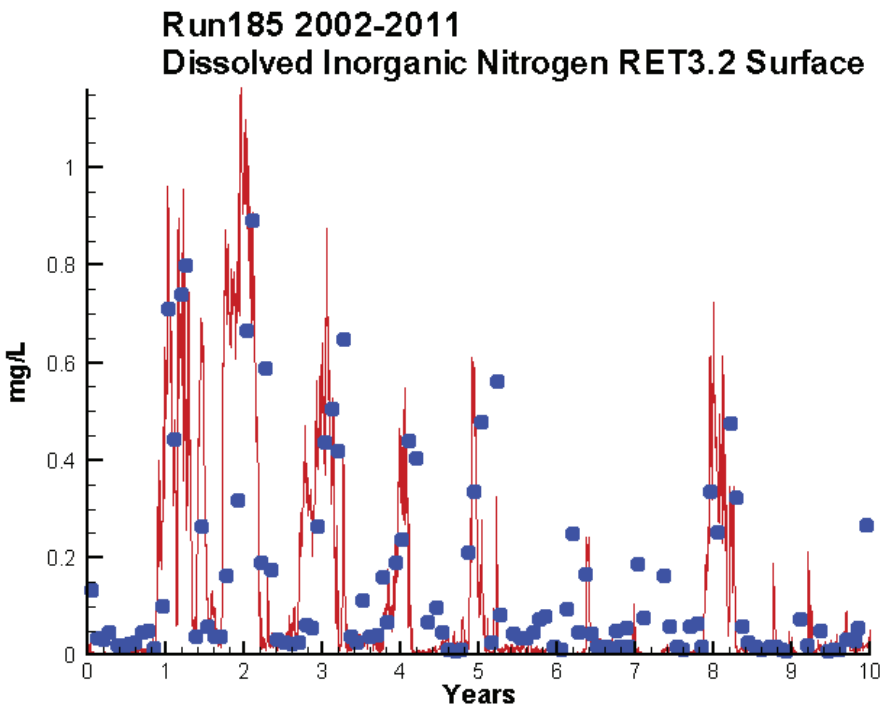


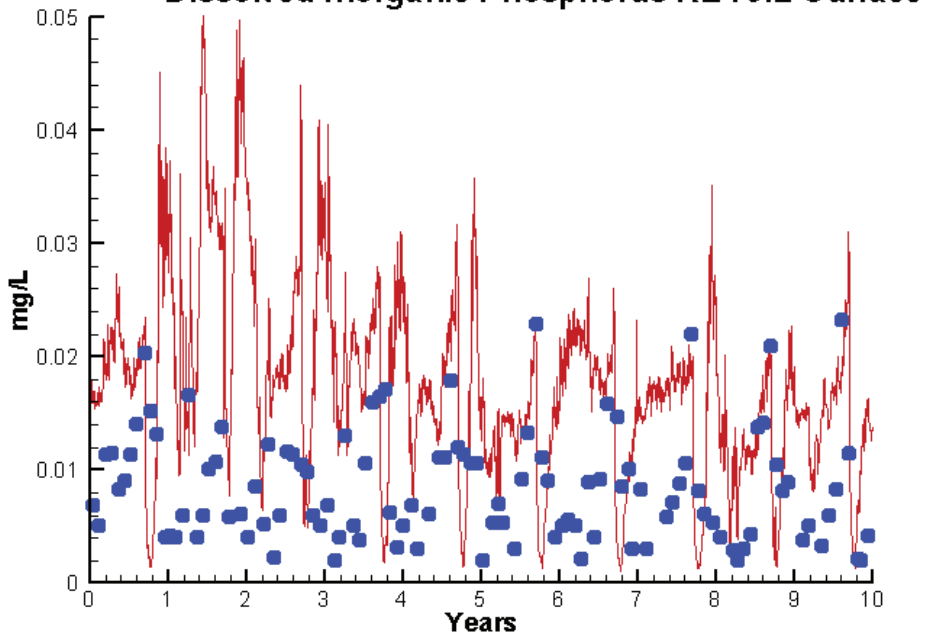
	Mean Difference	Absolute Mean Difference
KE	0.3002	0.3817
TSS	0.5221	3.0569

Station RET3.2

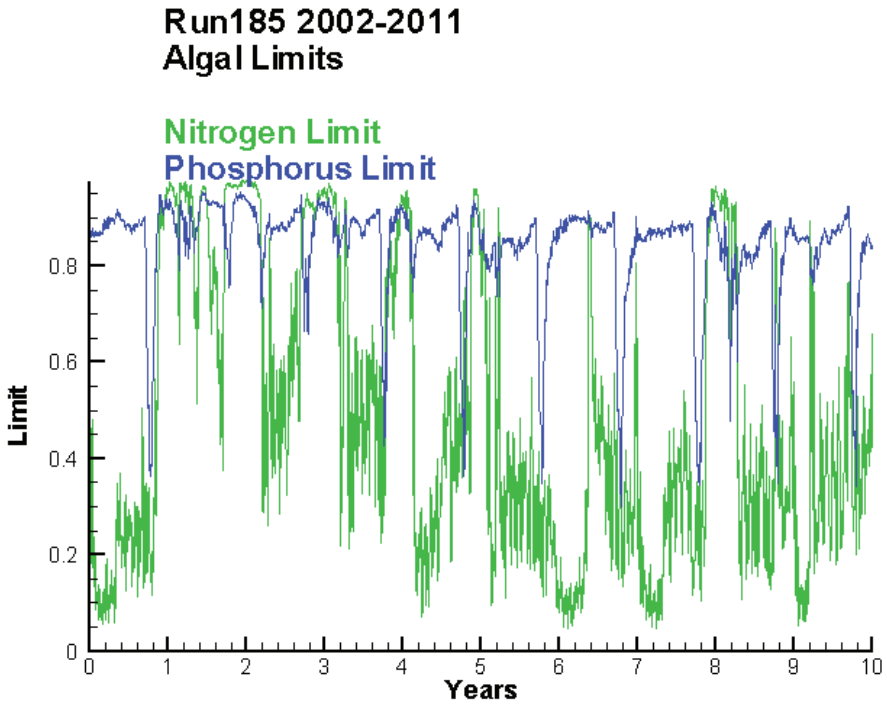


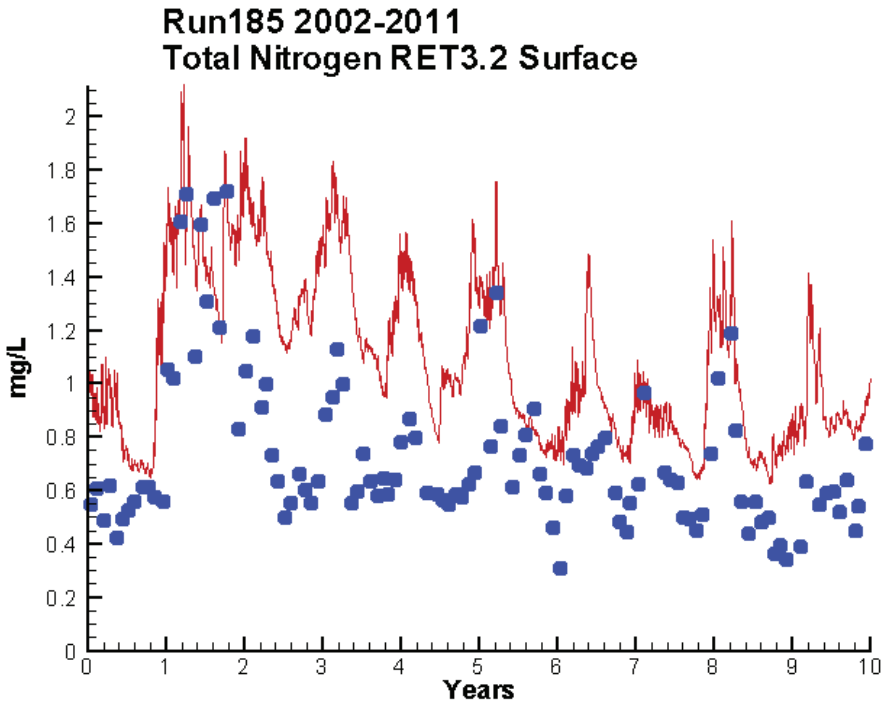


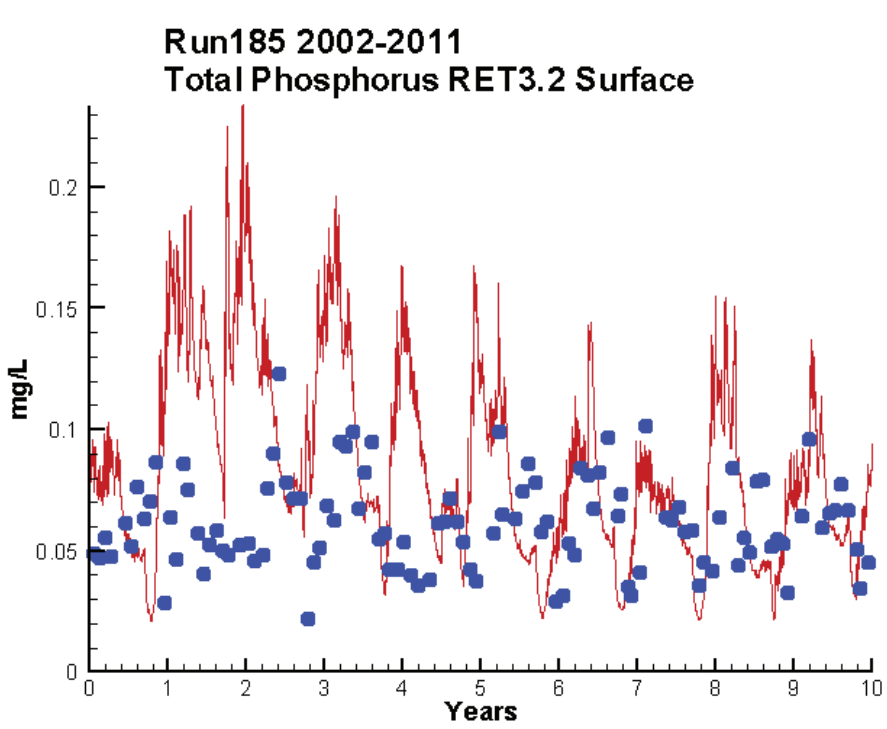




Station RET3.2

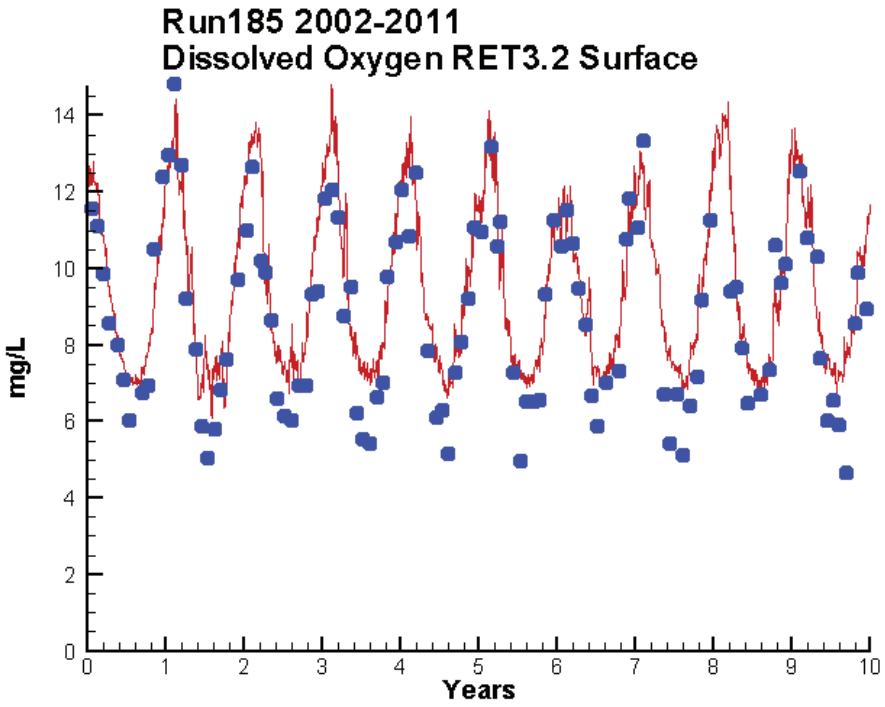


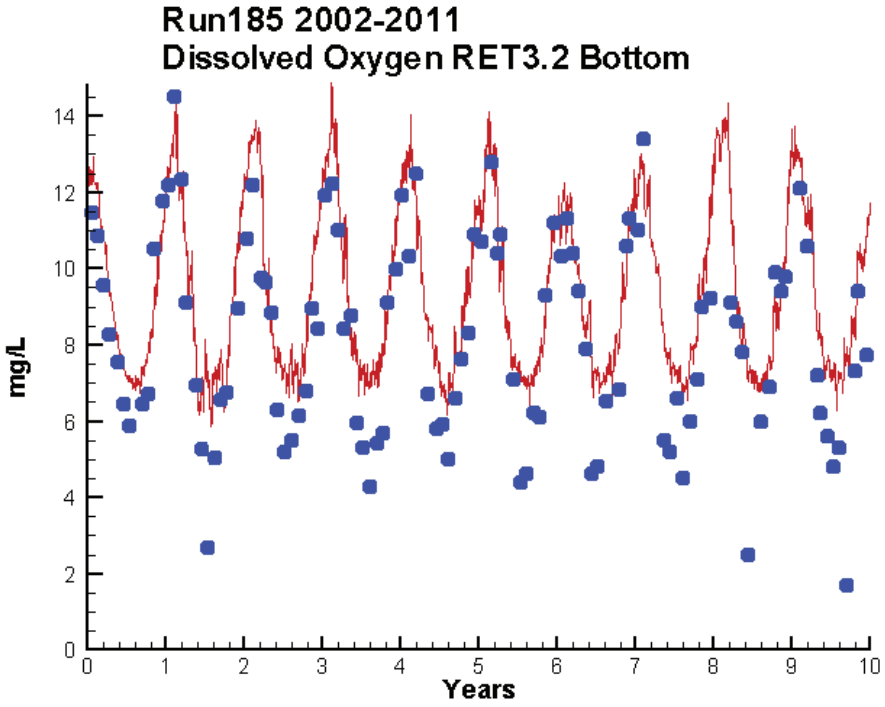




	Mean Difference	Absolute Mean Difference
Chl	-1.1918	5.7597
DIN	-0.0275	0.0964
KE	0.3215	0.8660
DIP	0.0091	0.0111
TP	0.0239	0.0389
TN	0.3669	0.3778

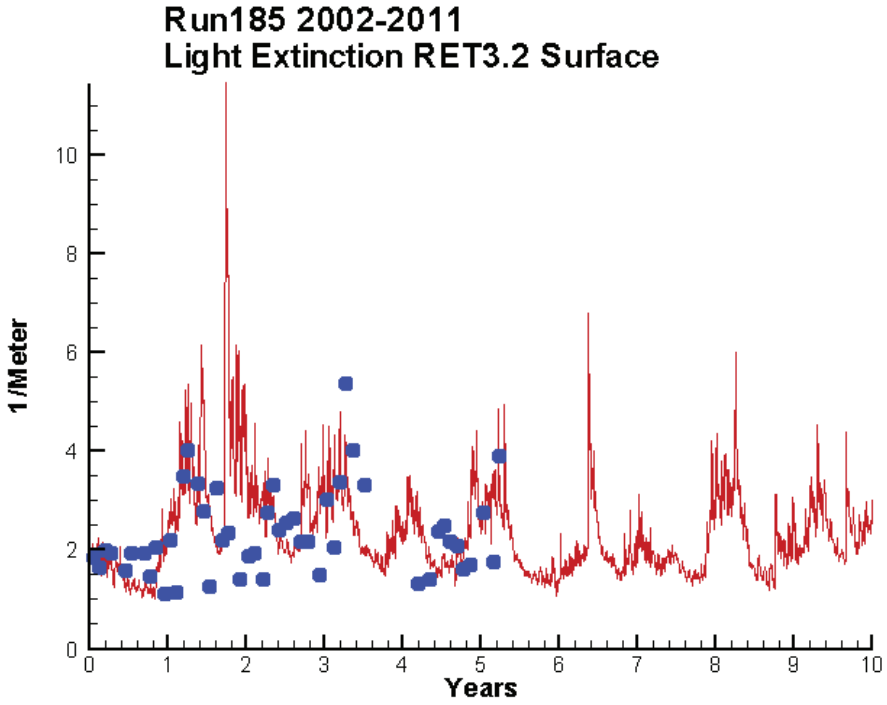
Station RET3.2

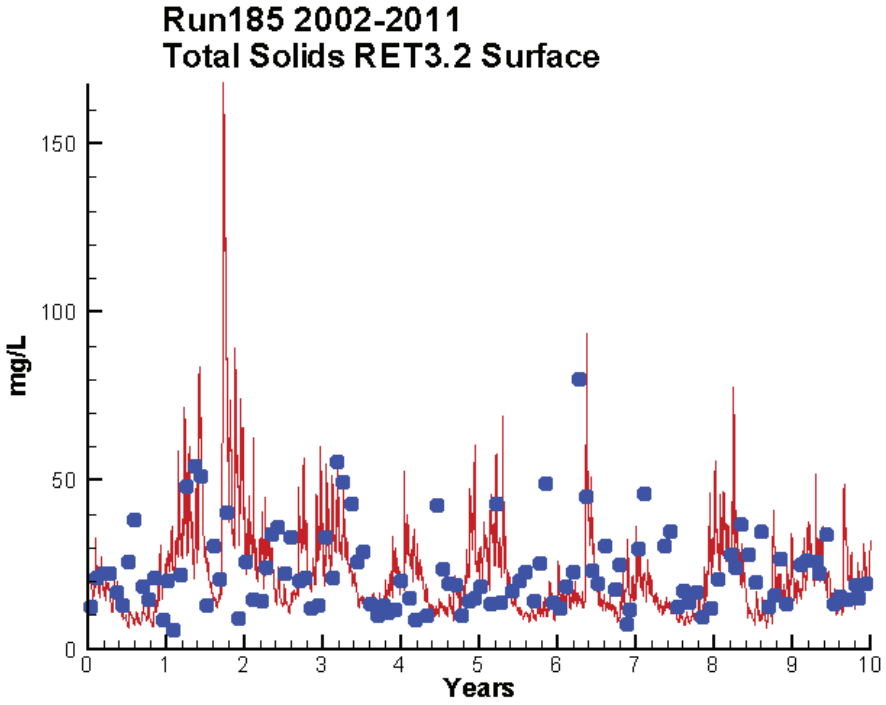


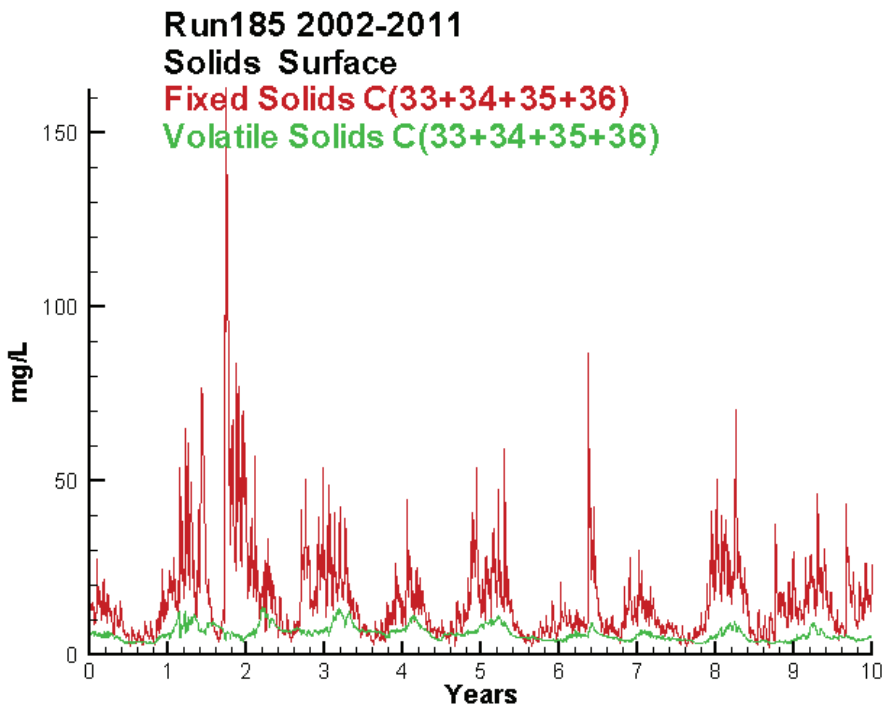


	Mean Difference	Absolute Mean Difference
Top DO	0.6870	0.9843
Bot DO	1.2016	1.3714

Station RET3.2

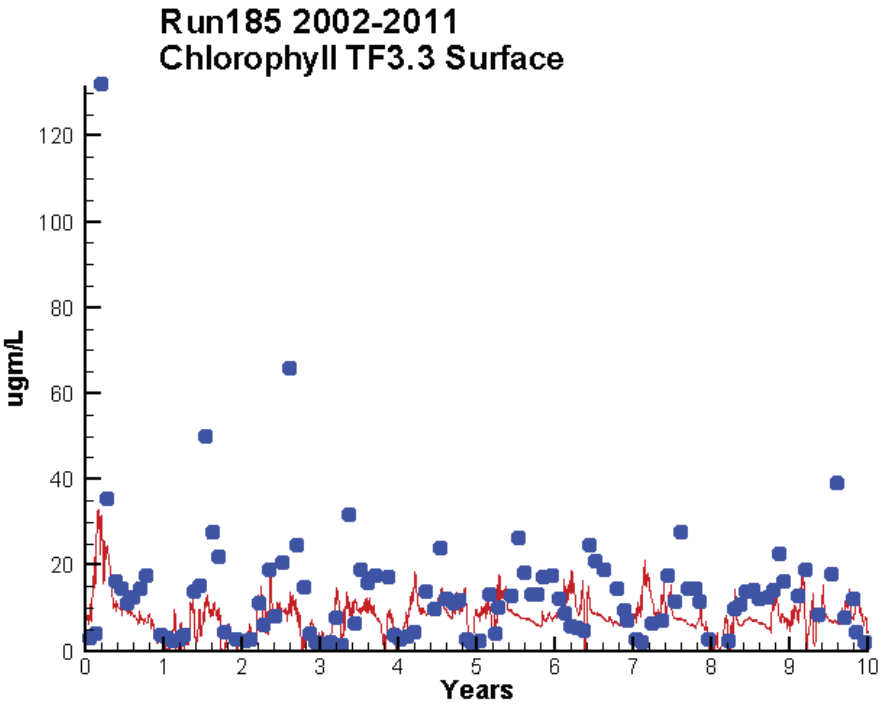


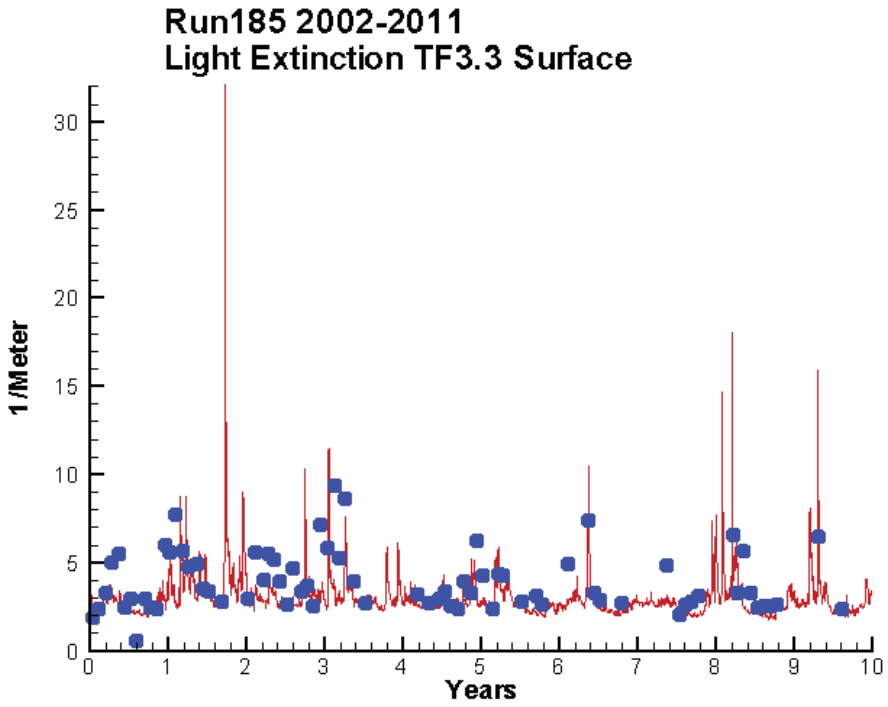


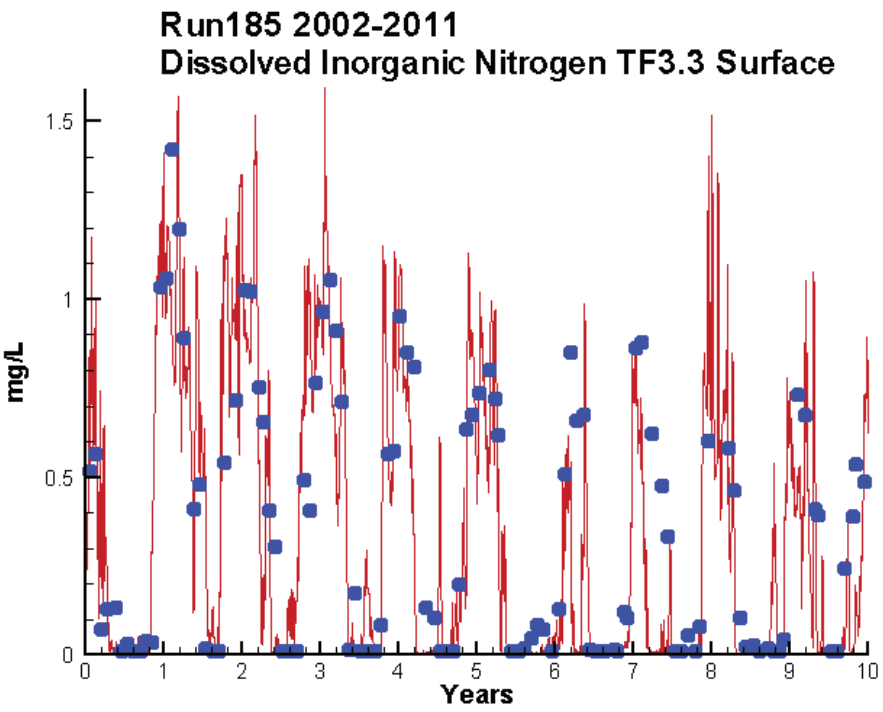


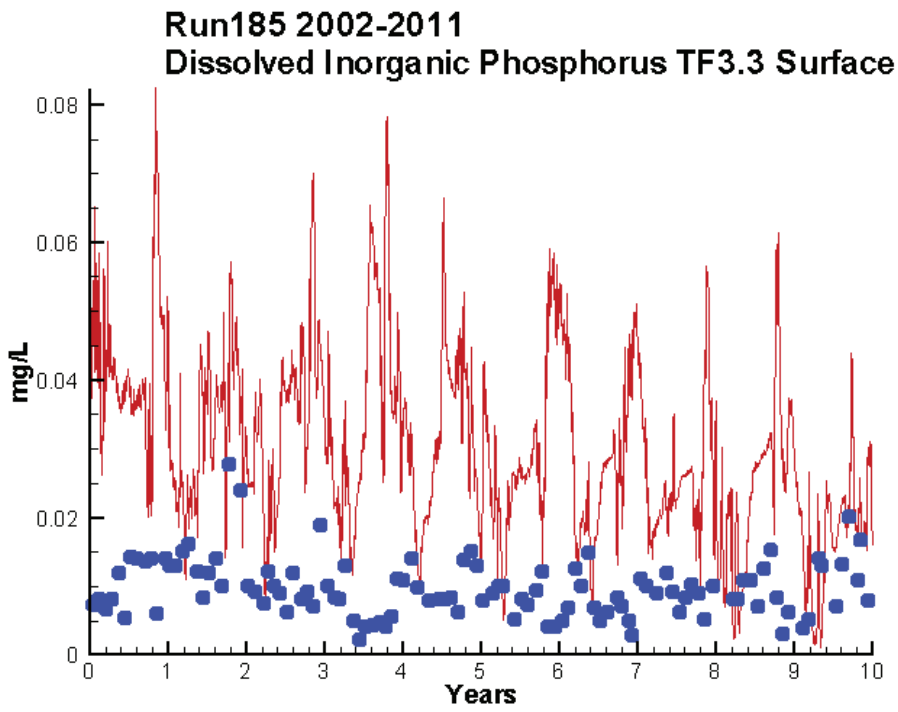
	Mean Difference	Absolute Mean Difference
KE	0.3215	0.8660
TSS	-1.0123	11.0025

Station TF3.3

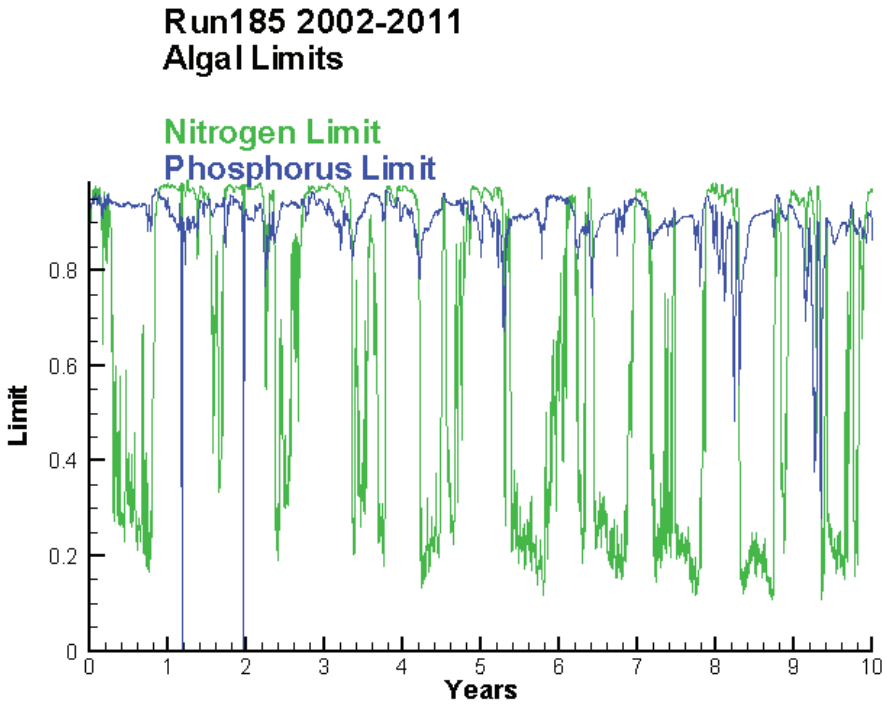


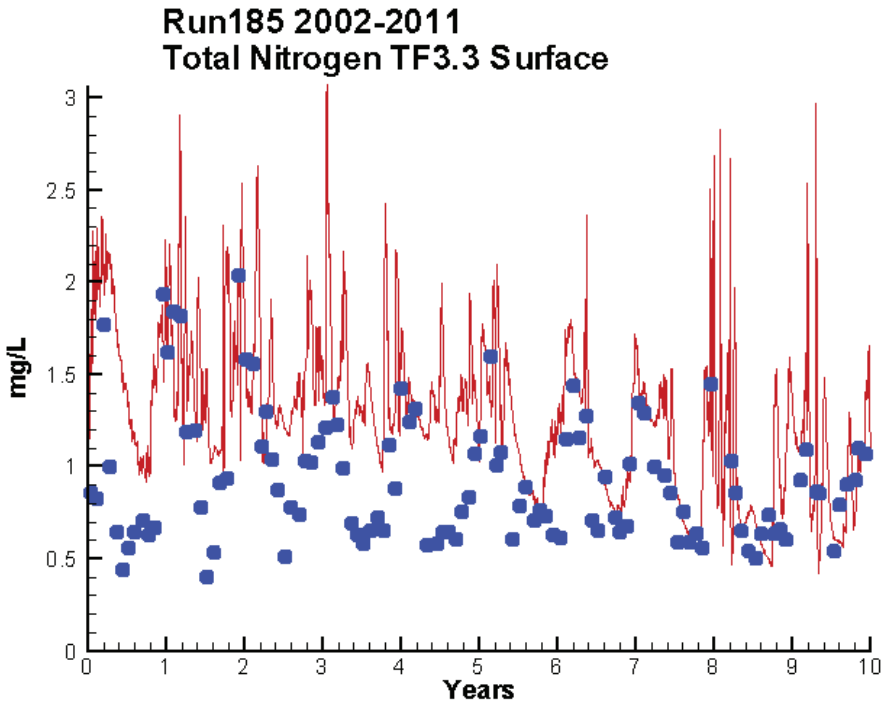


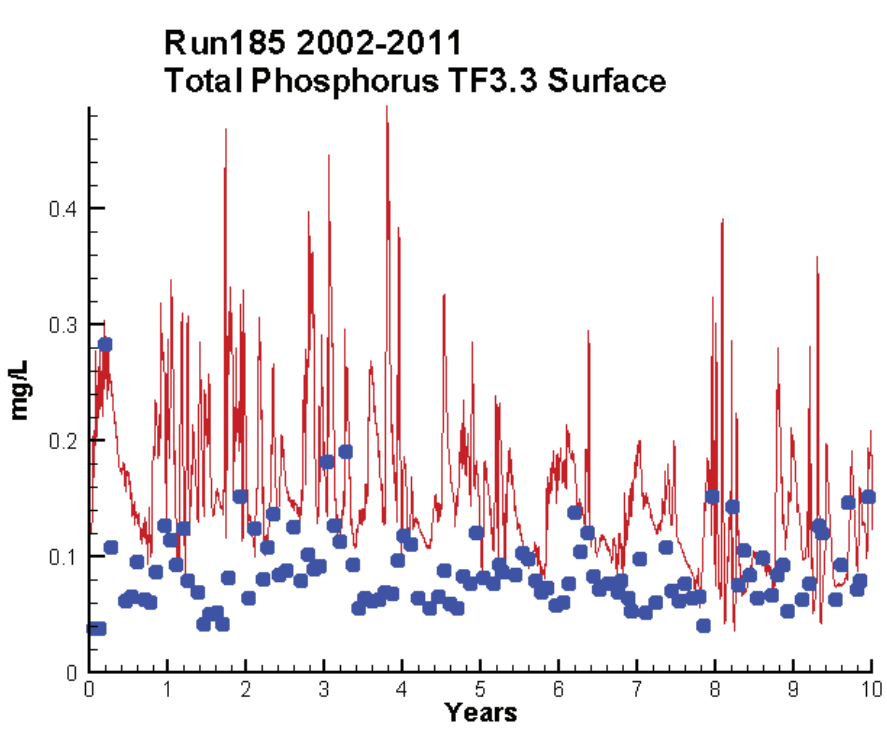




Station TF3.3

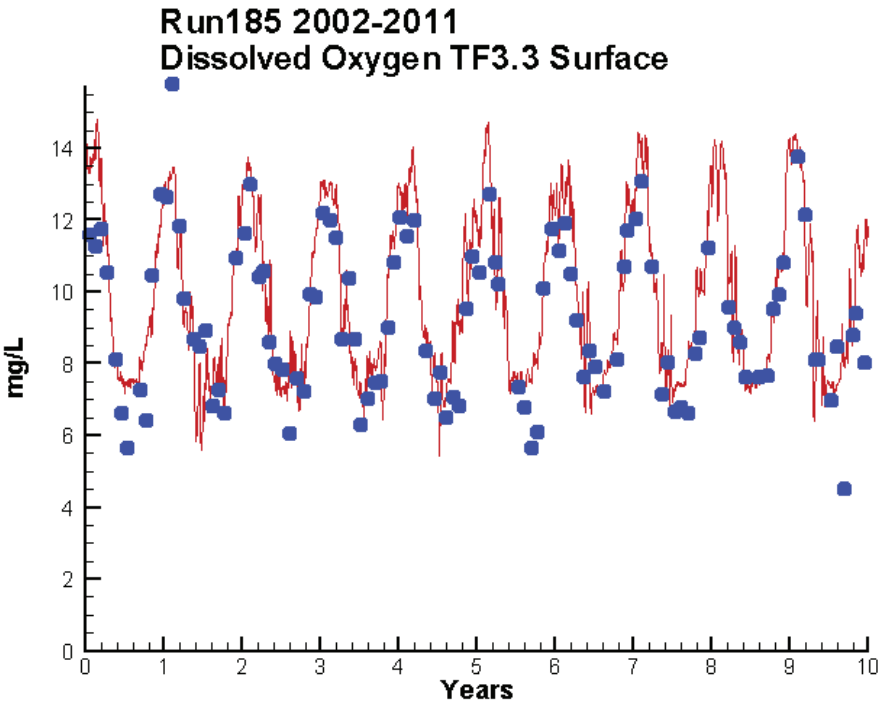






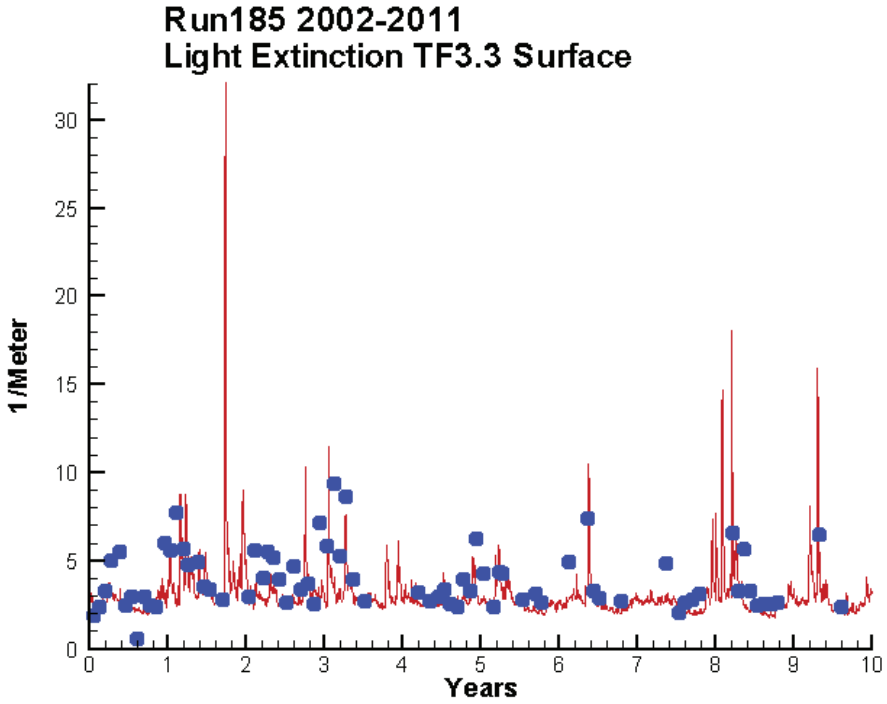
	Mean Difference	Absolute Mean Difference
Chl	-5.1296	8.0606
DIN	-0.0265	0.1719
KE	-0.9014	1.1738
DIP	0.0215	0.0219
TP	0.0702	0.0756
TN	0.3586	0.4193

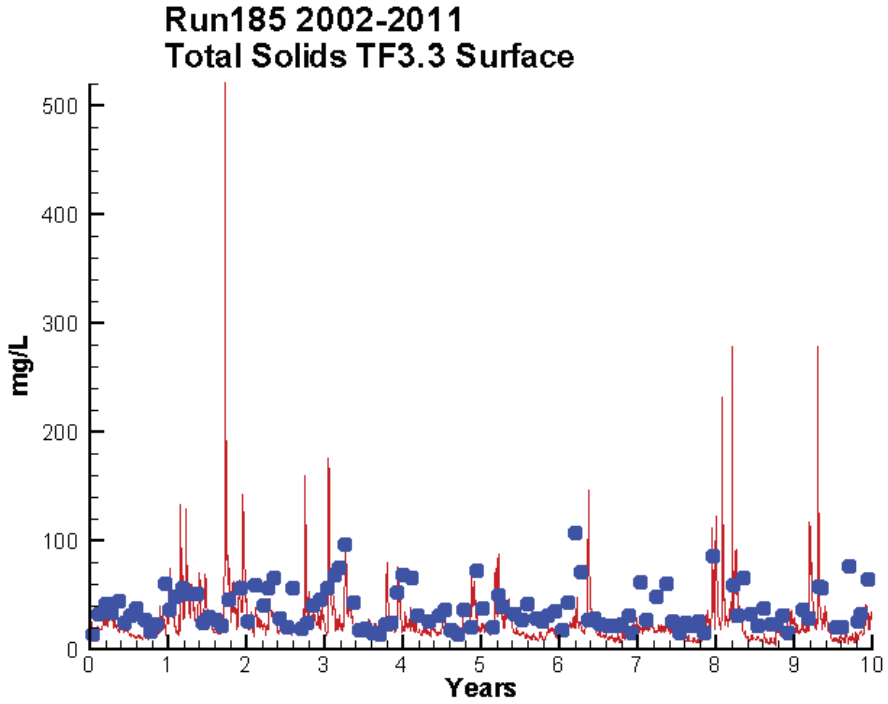
Station TF3.3

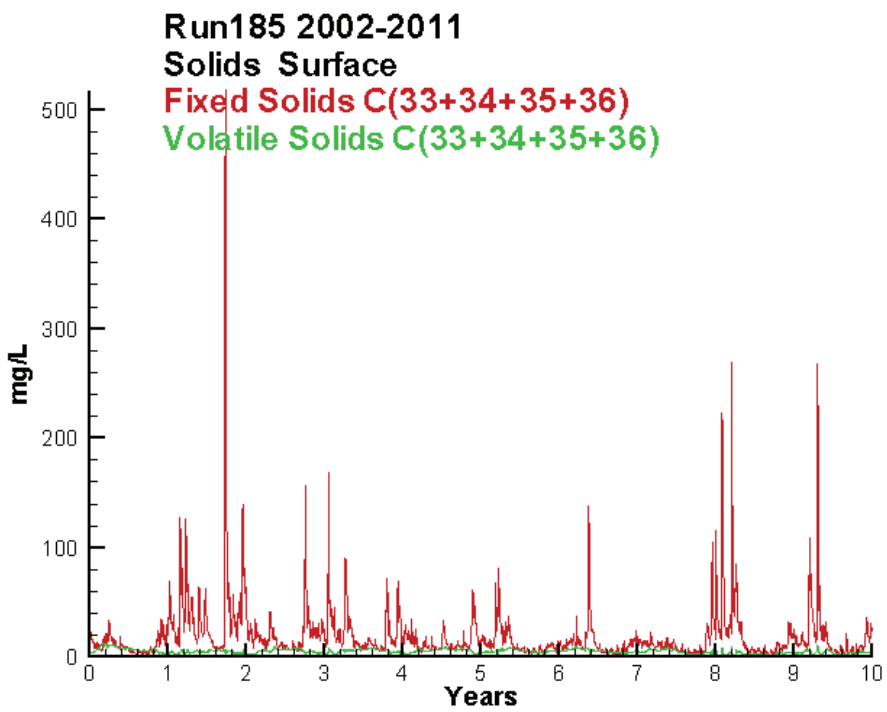


	Mean Difference	Absolute Mean Difference
Top DO	0.6379	0.9528

Station TF3.3

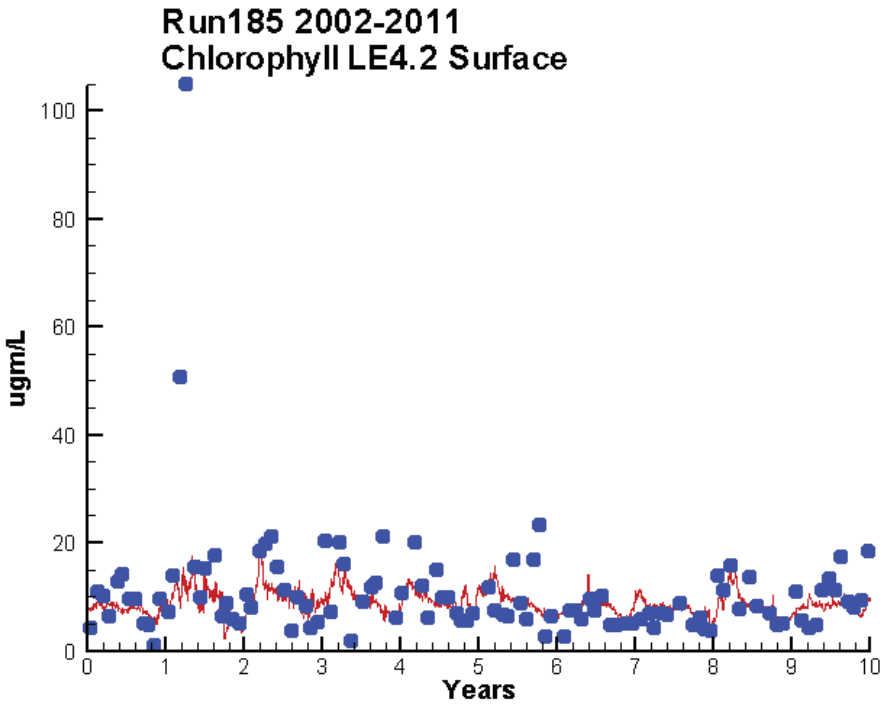


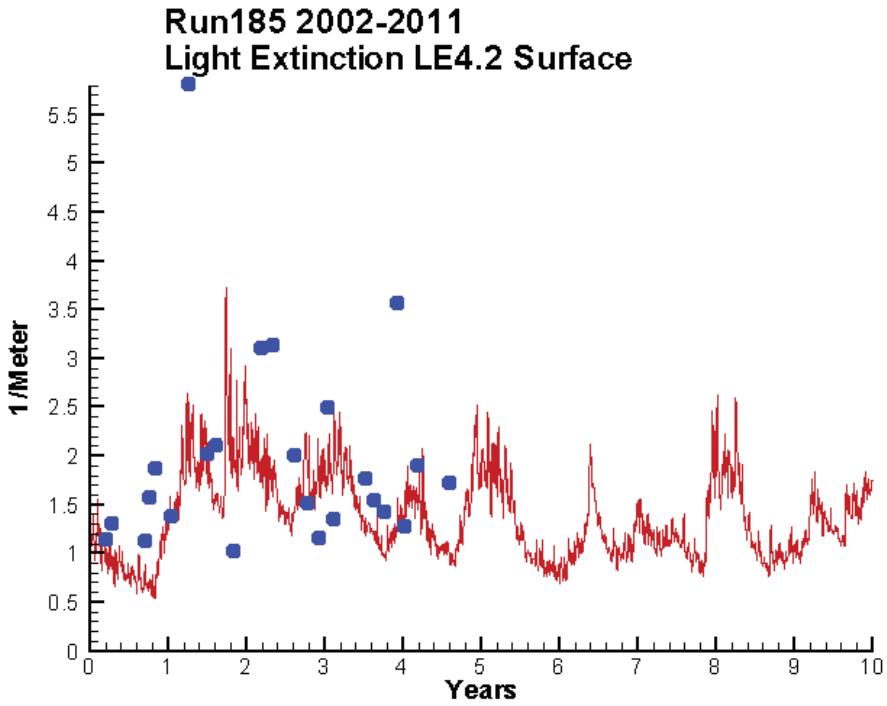


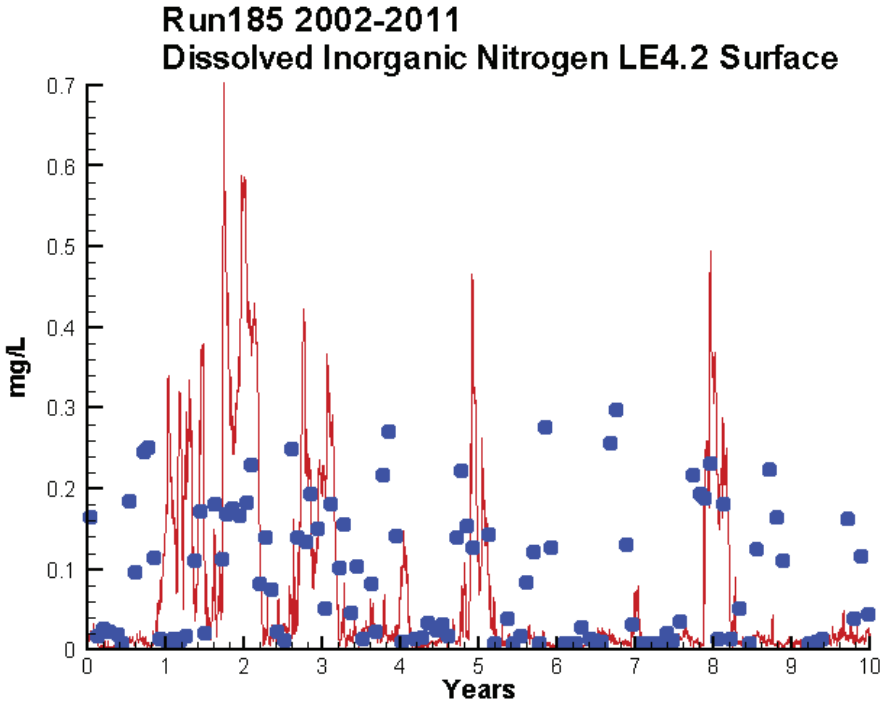


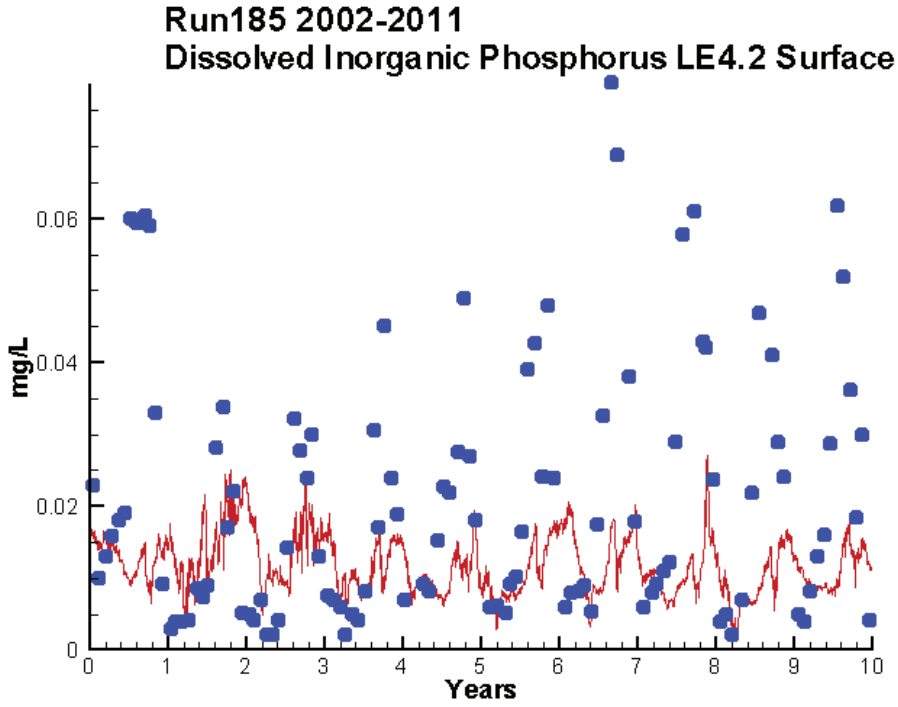
	Mean Difference	Absolute Mean Difference
KE	-0.9014	1.1738
TSS	-12.3532	19.5607

Station LE4.2

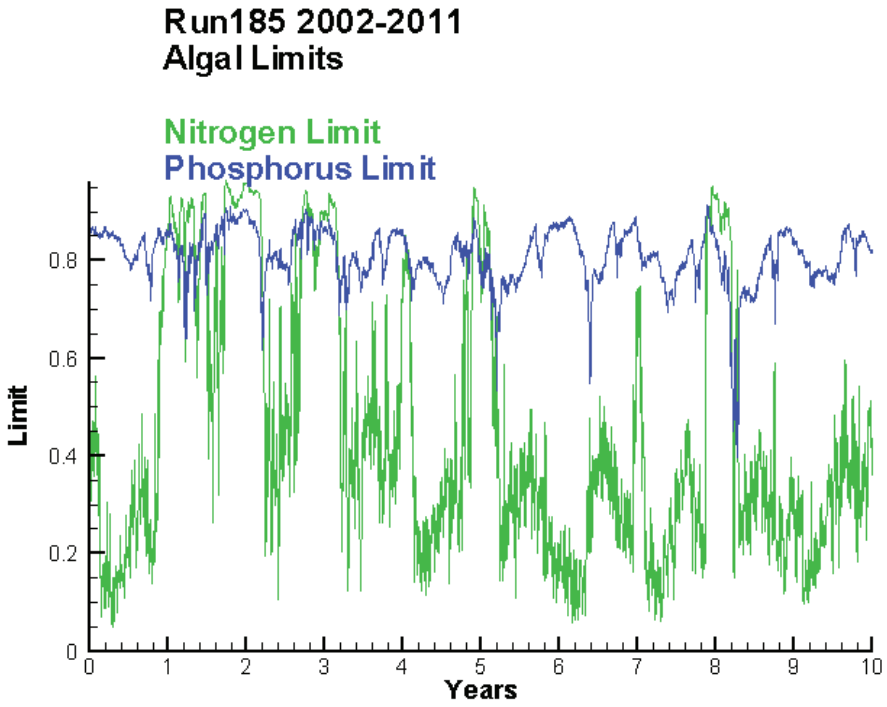


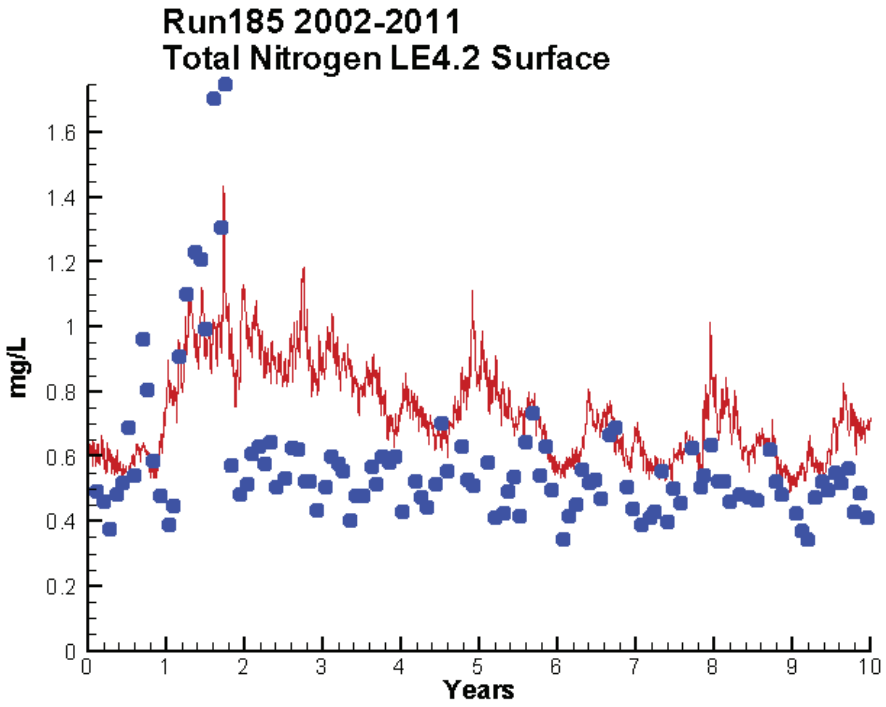


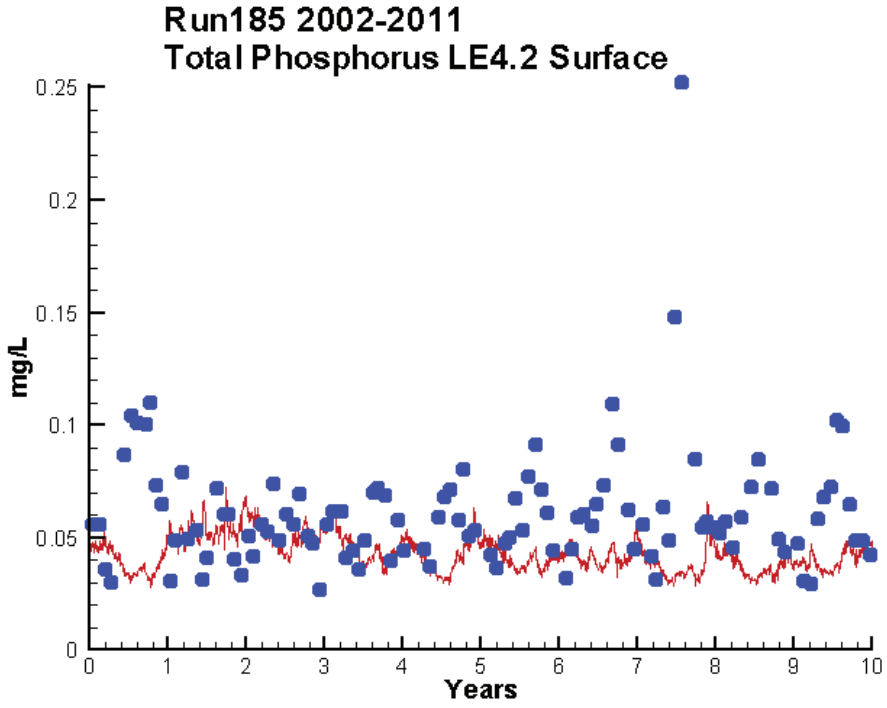




Station LE4.2

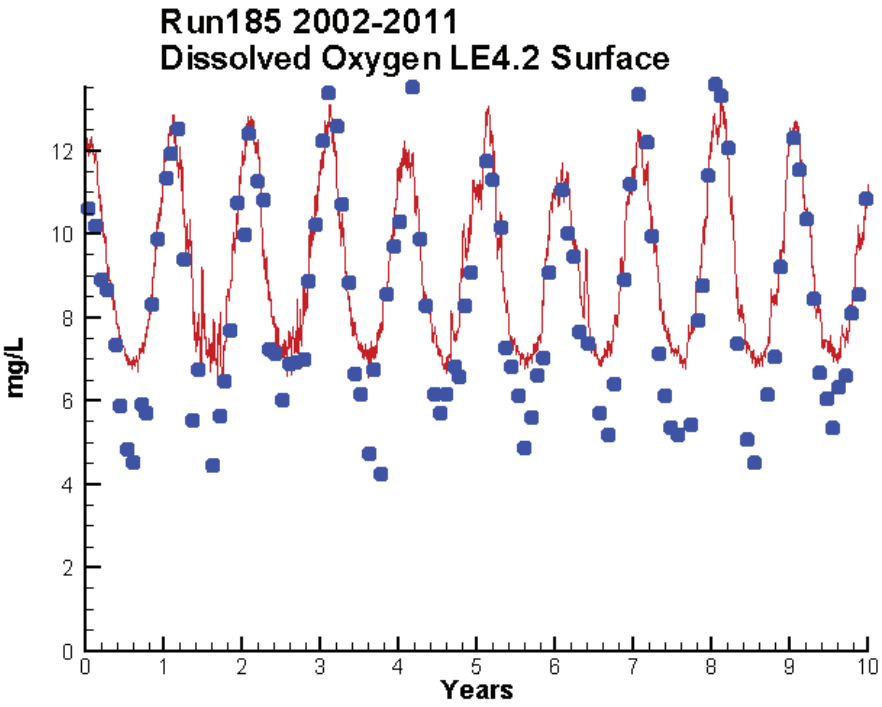


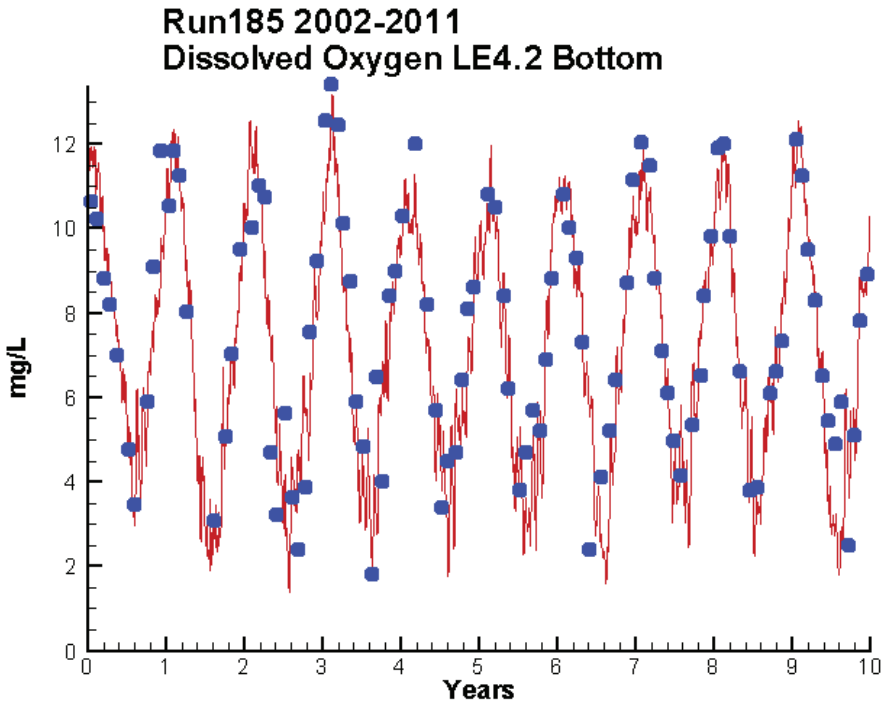


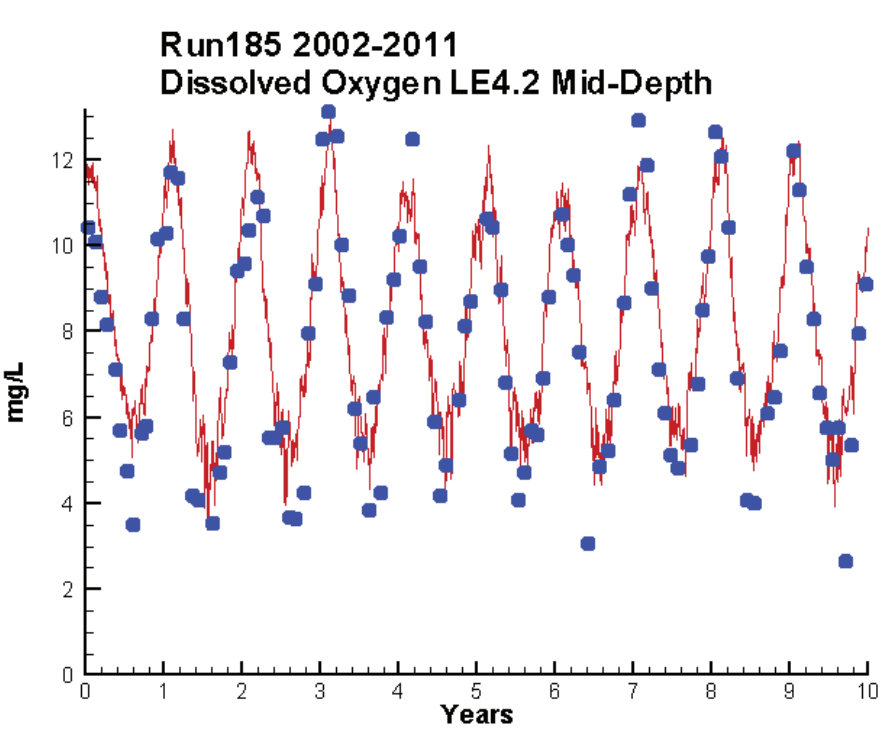


	Mean Difference	Absolute Mean Difference
Chl	-1.8234	4.5072
DIN	-0.0242	0.0864
KE	-0.5701	0.7623
DIP	-0.0090	0.0133
TP	-0.0173	0.0223
TN	0.1619	0.2161

Station LE4.2

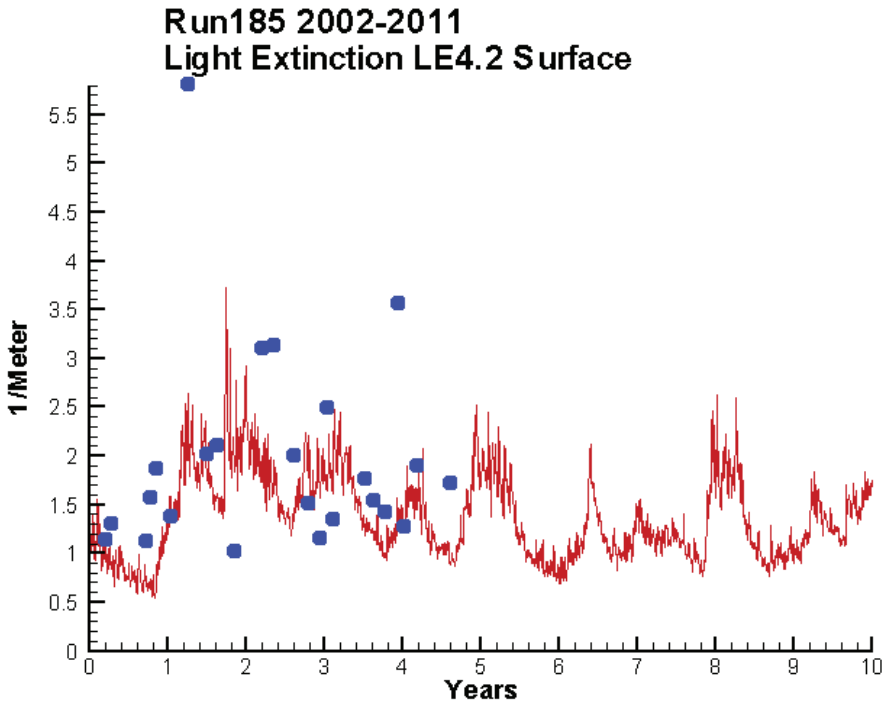


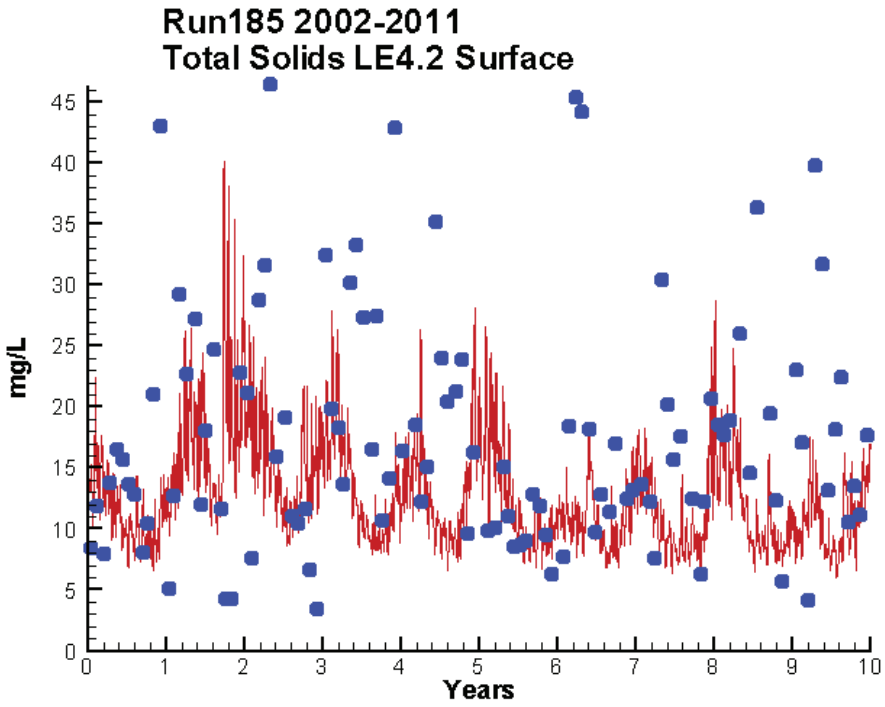


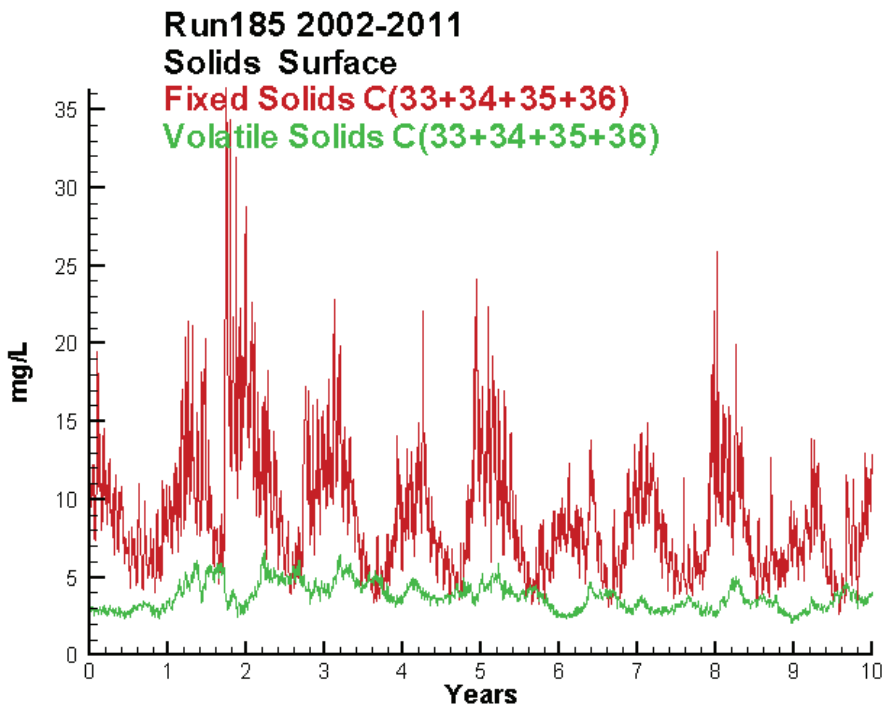


	Mean Difference	Absolute Mean Difference
Top DO	0.8620	1.1115
Mid DO	0.7054	0.9900
Bot DO	-0.0948	0.8960

Station LE4.2

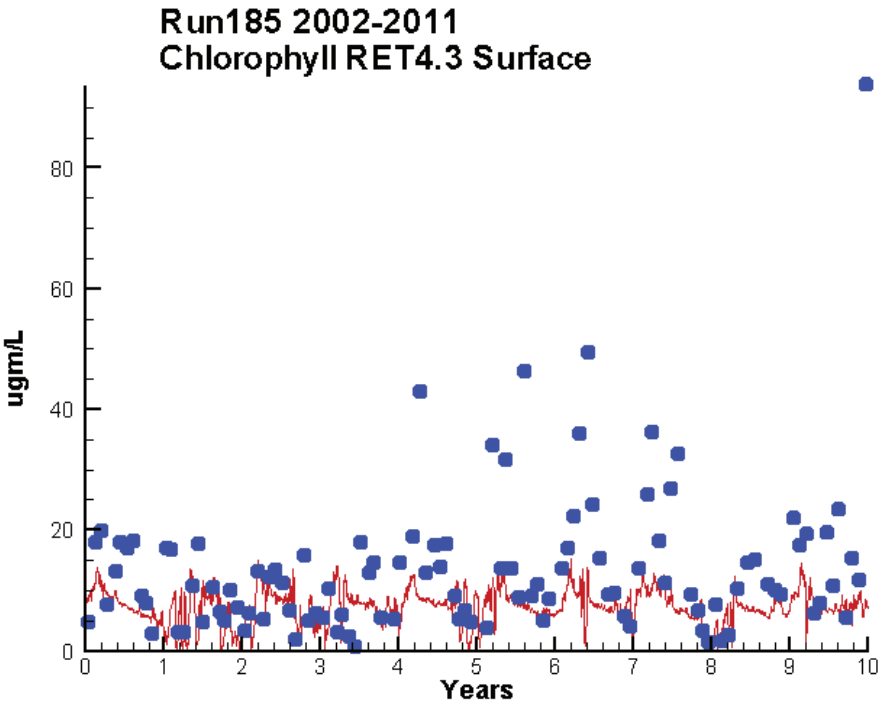


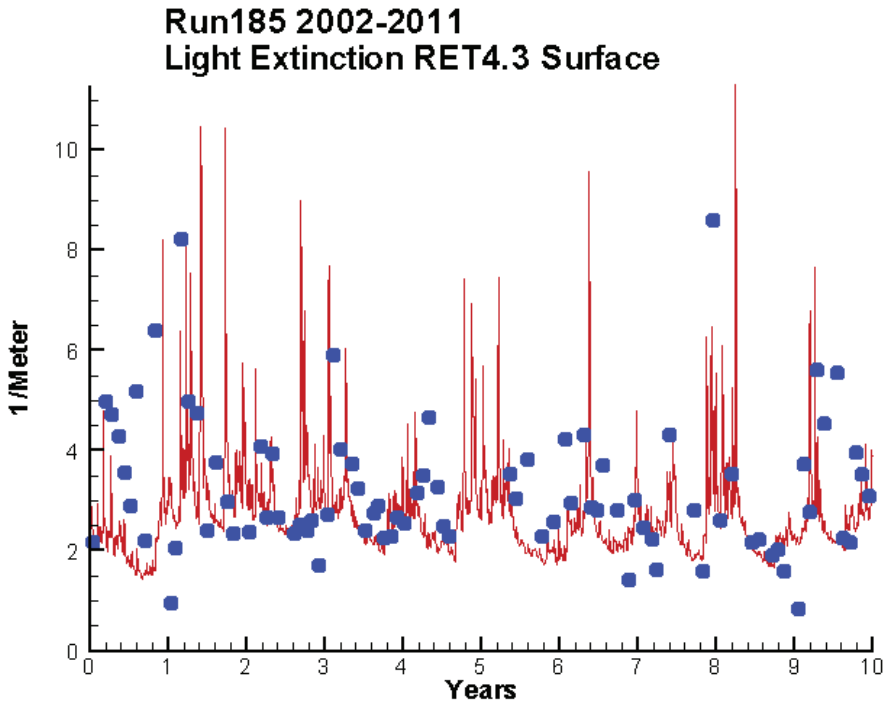


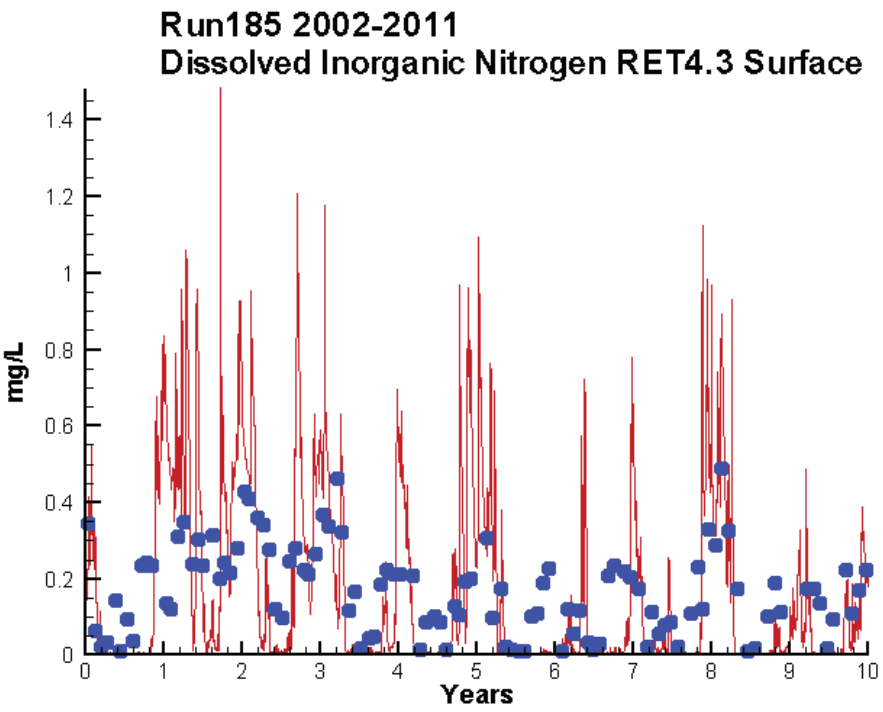


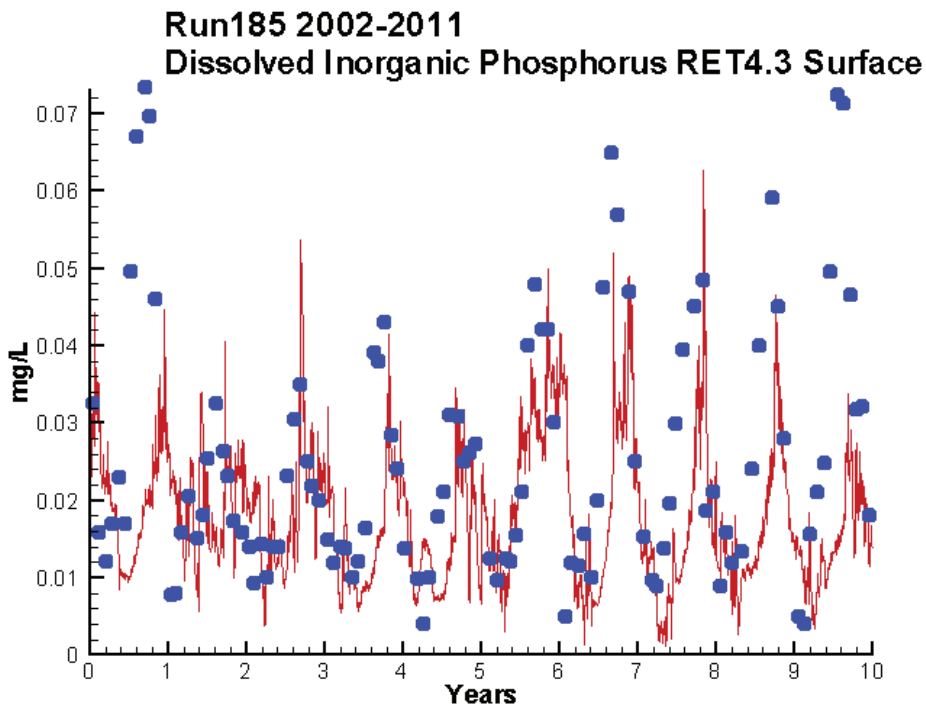
	Mean Difference	Absolute Mean Difference
KE	-0.5701	0.7623
TSS	-4.8857	7.5413

Station RET4.3

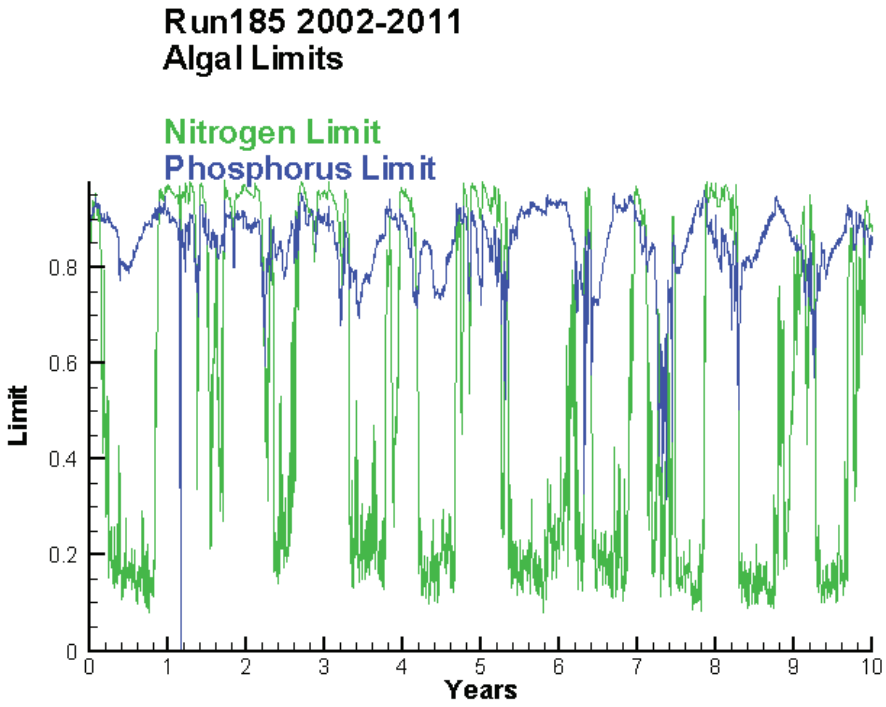


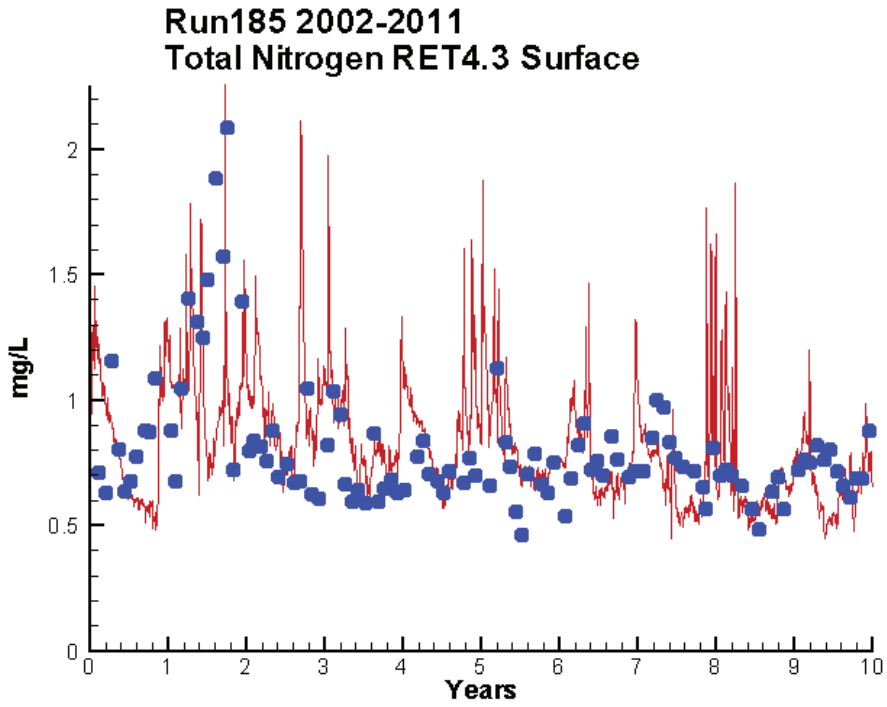


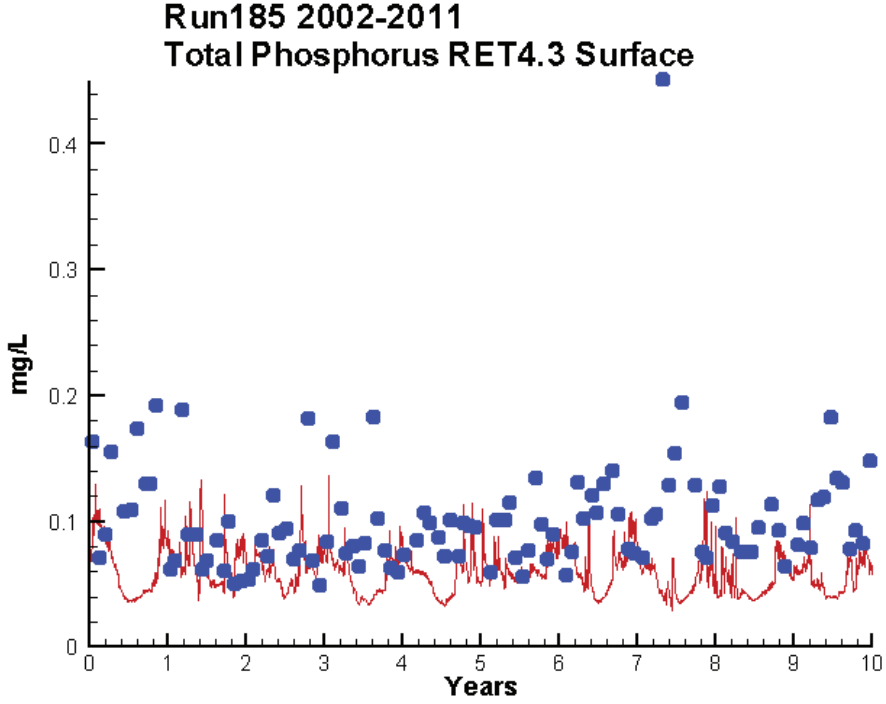




Station RET4.3

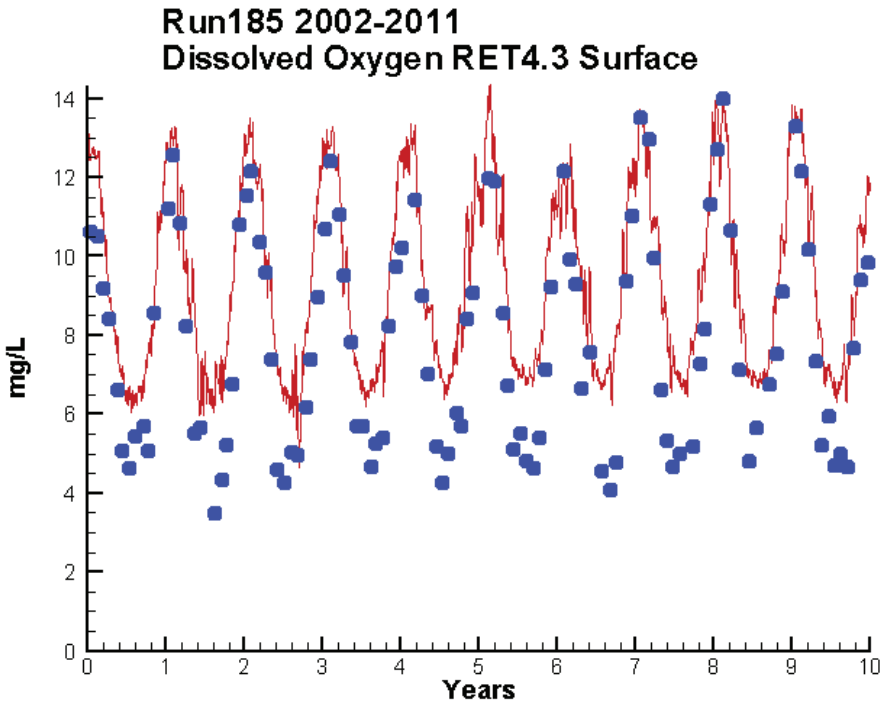




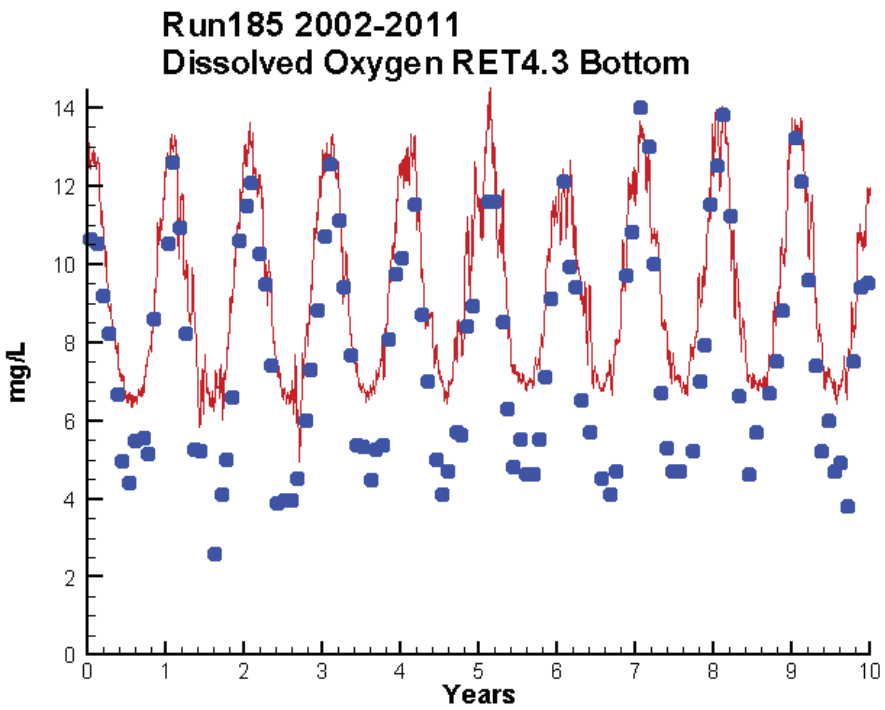


	Mean Difference	Absolute Mean Difference
Chl	-5.9294	7.6531
DIN	-0.0091	0.1316
KE	-0.6395	1.0228
DIP	-0.0083	0.0124
TP	-0.0425	0.0469
TN	0.0169	0.2114

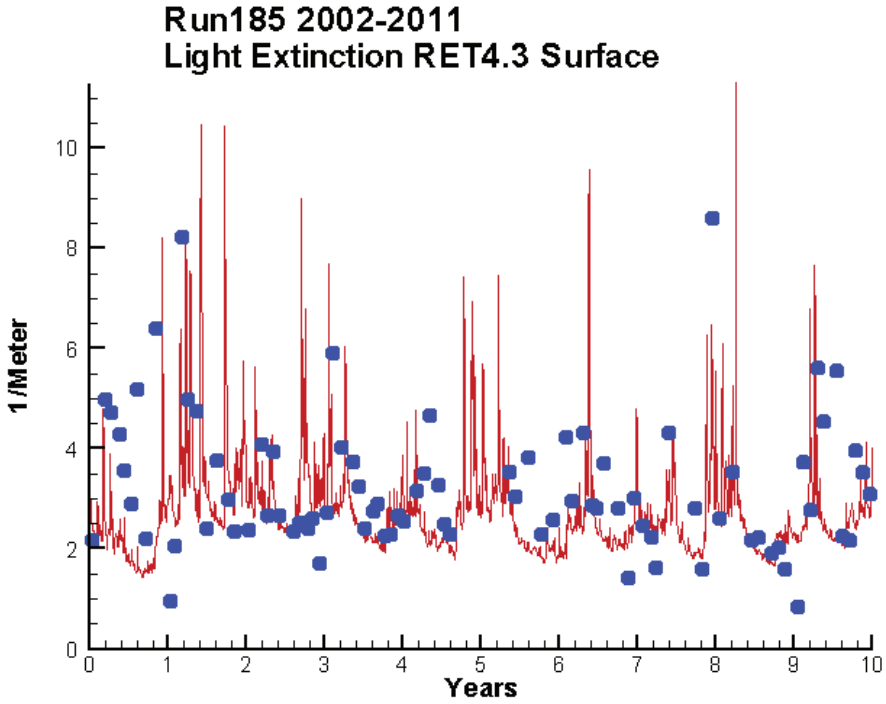
Station RET4.3

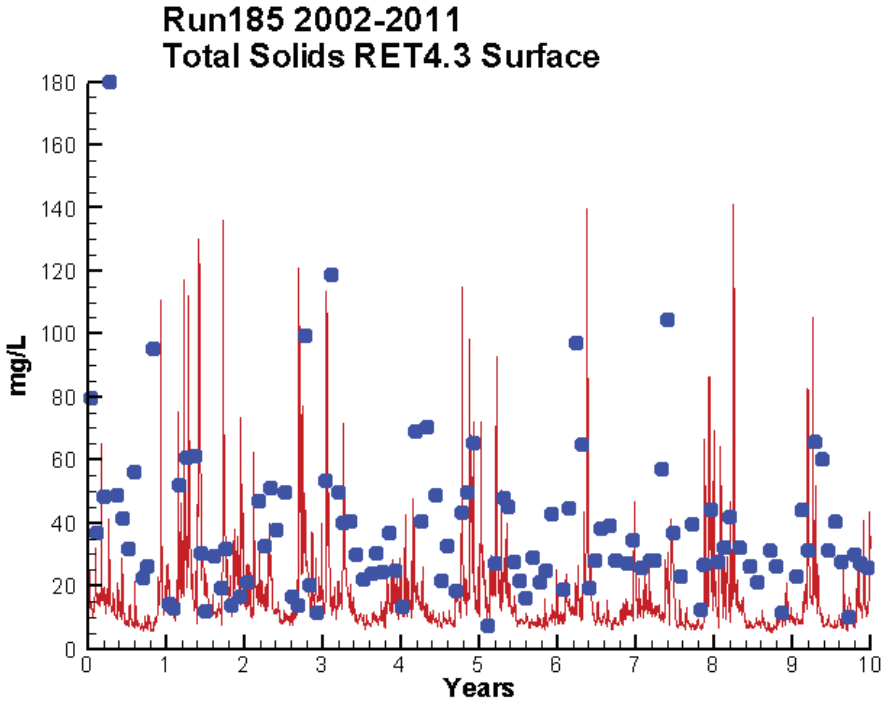


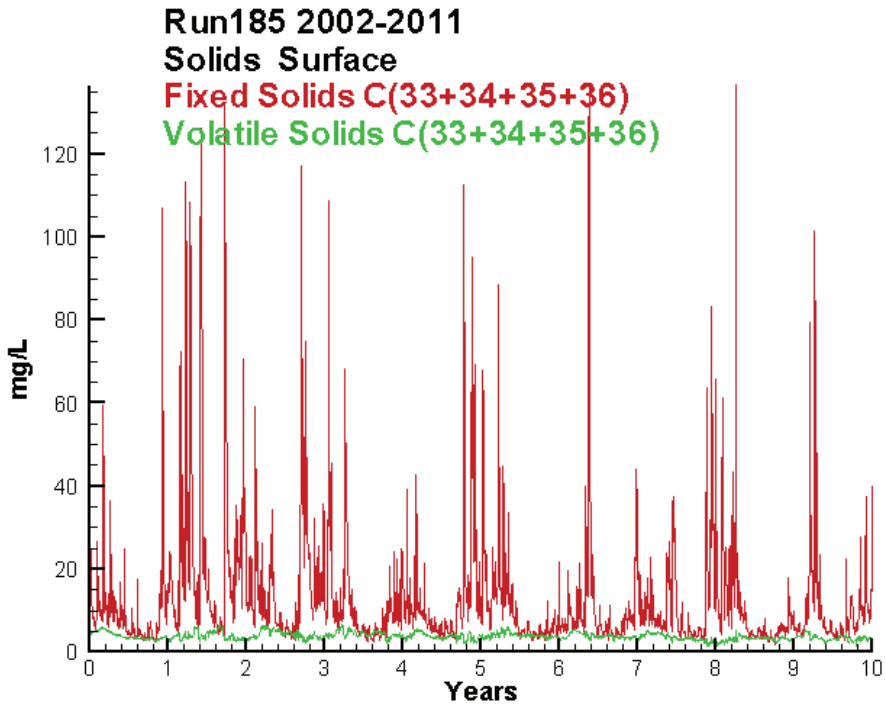
	Mean Difference	Absolute Mean Difference
Top DO	1.5776	1.6226
Bot DO	1.7271	1.7828



Station RET4.3

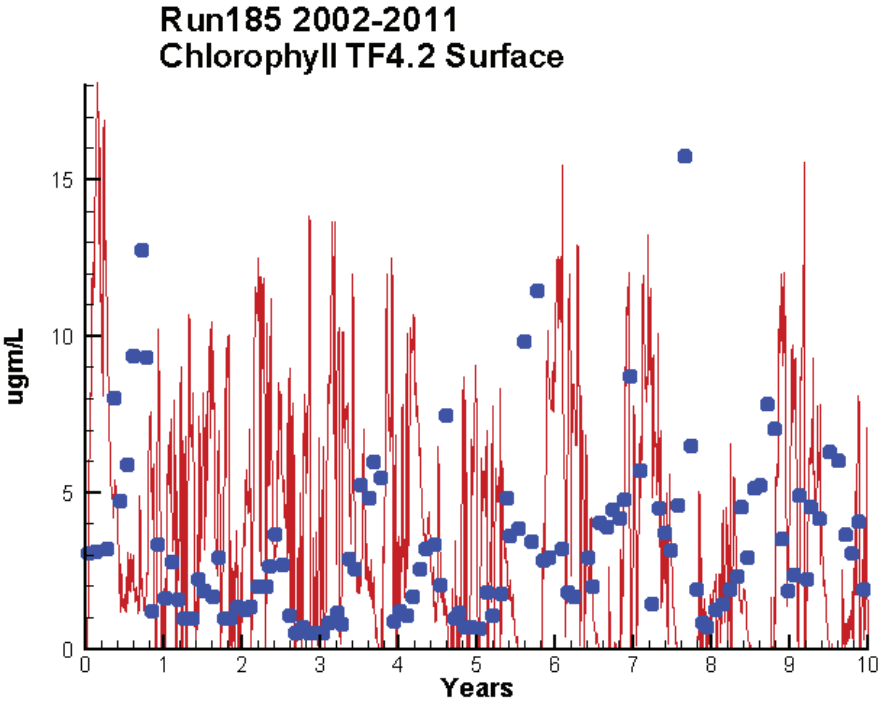


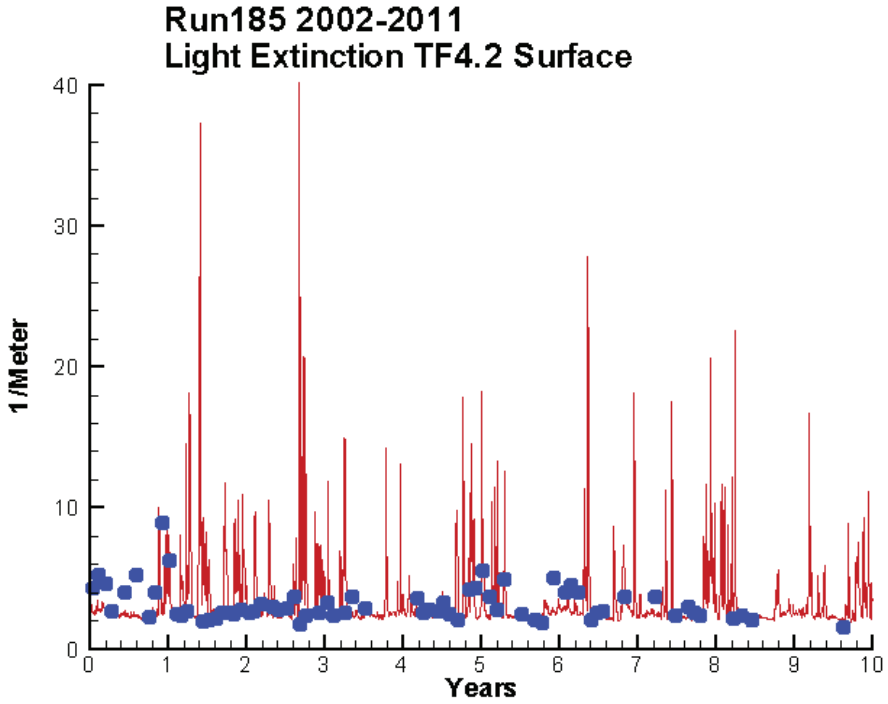


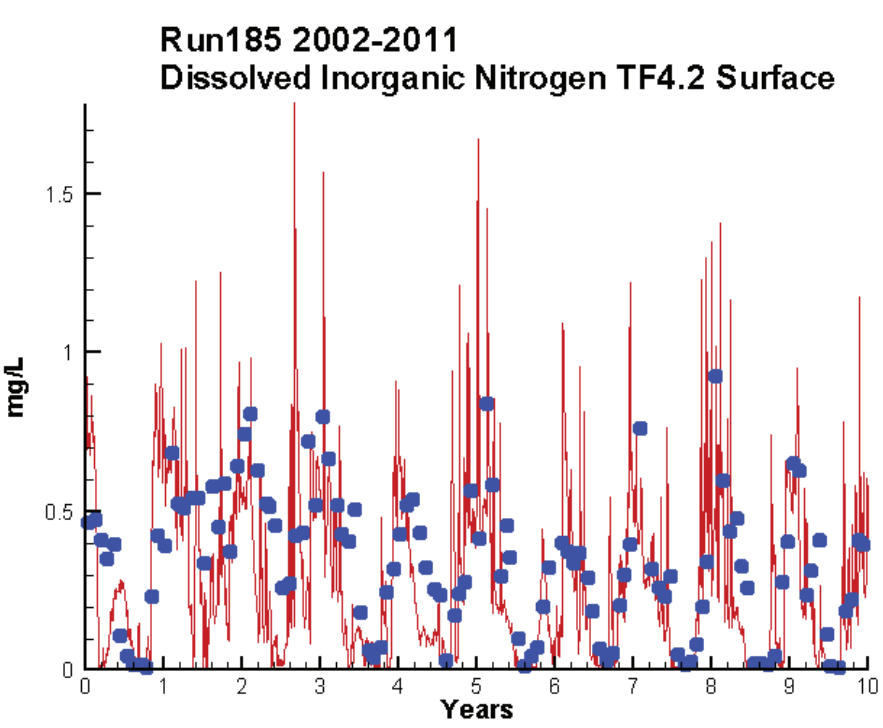


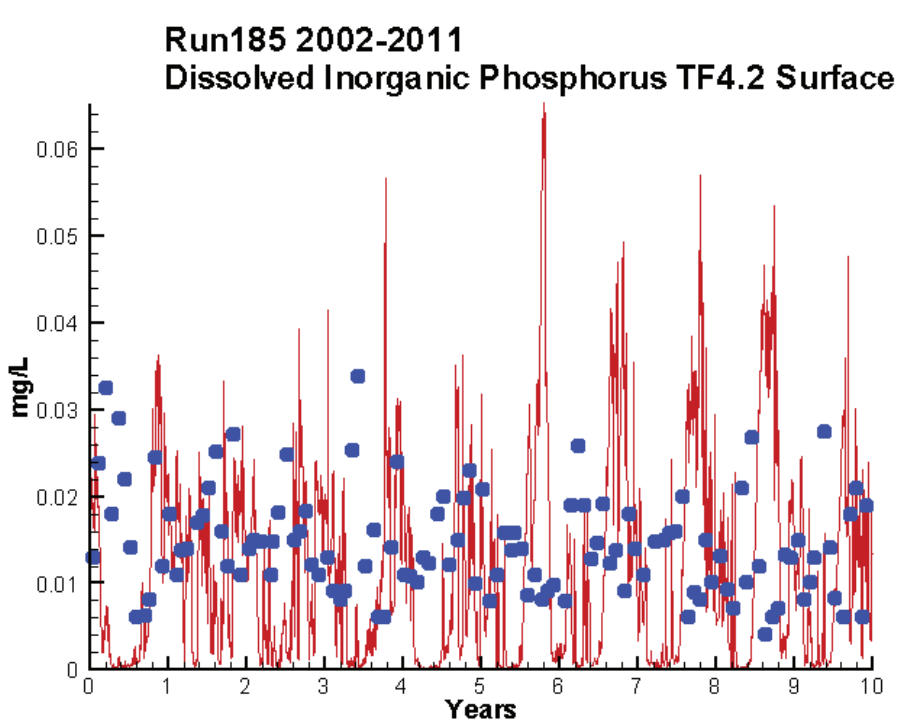
	Mean Difference	Absolute Mean Difference
KE	-0.6395	1.0228
TSS	-22.1149	24.4500

Station TF4.2

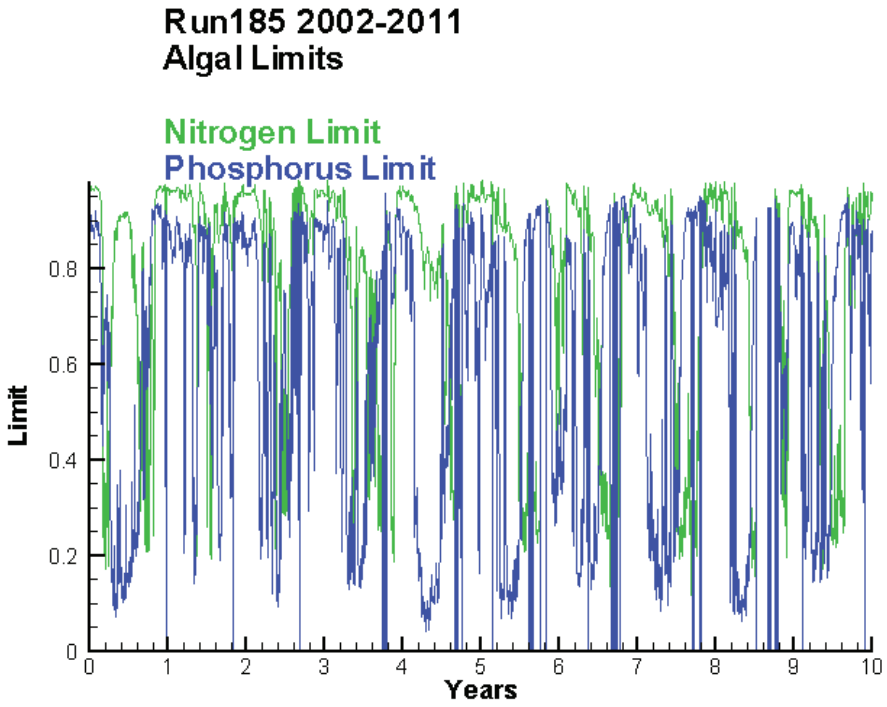


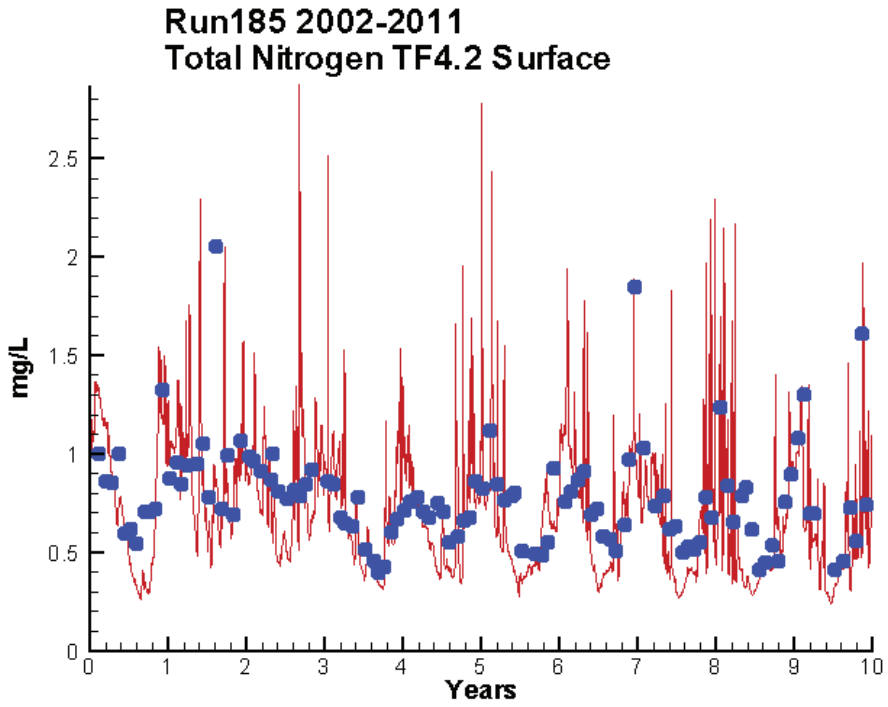


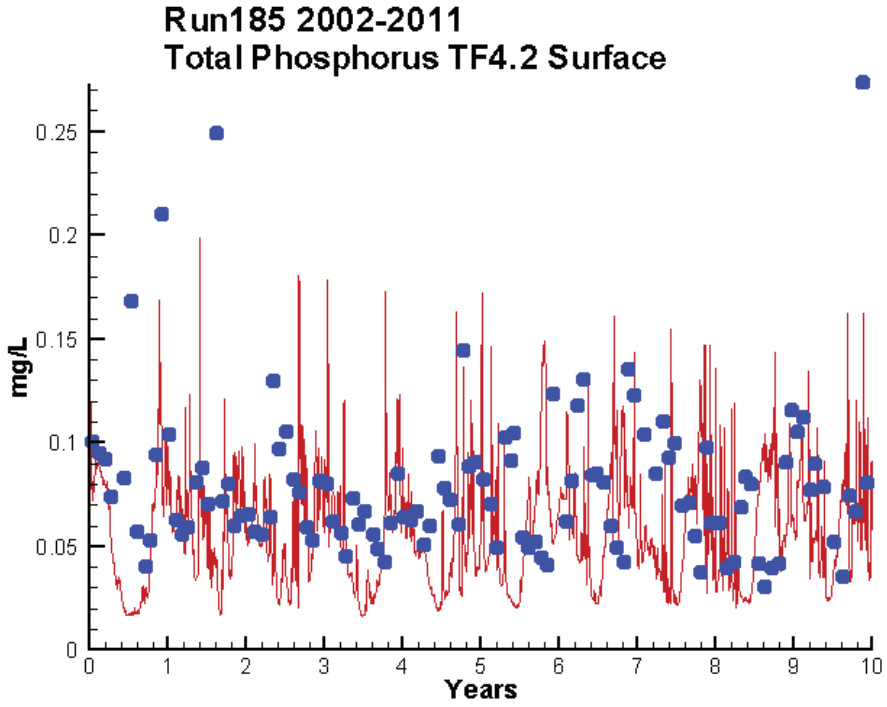




Station TF4.2

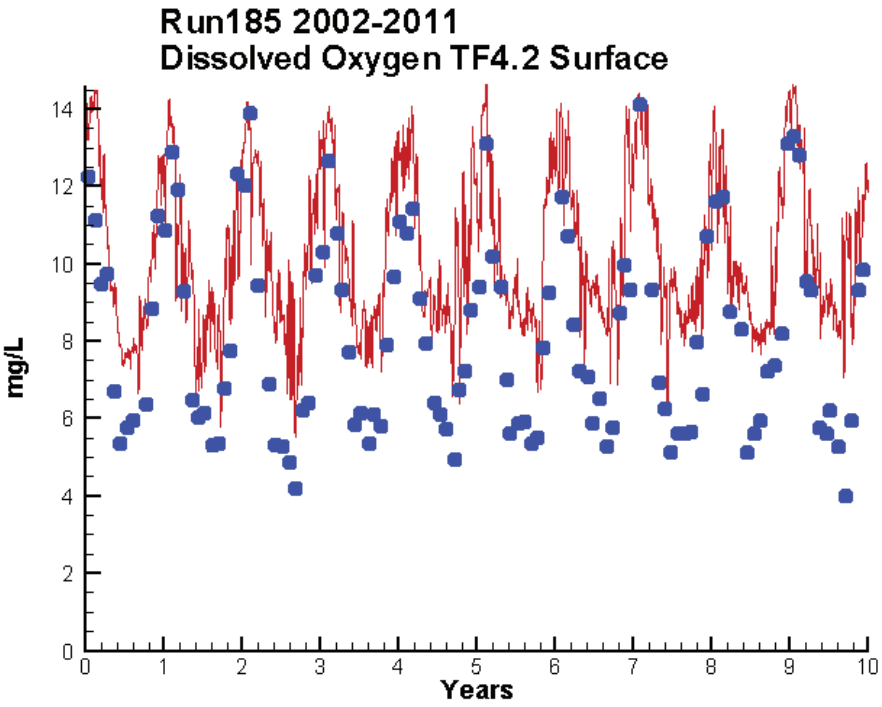






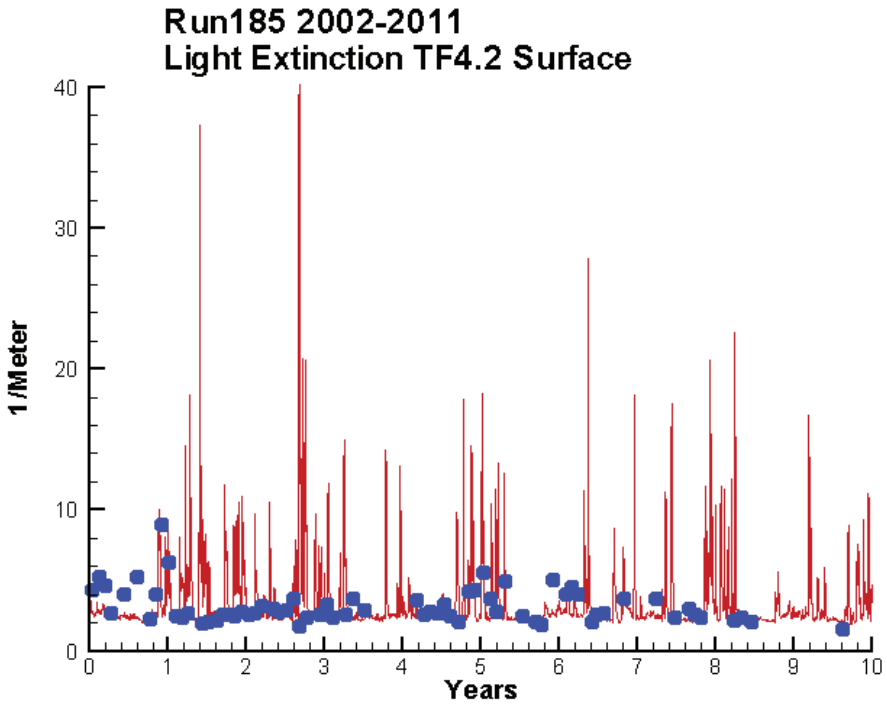
	Mean Difference	Absolute Mean Difference
Chl	0.3433	3.8476
DIN	-0.0631	0.1704
KE	0.2348	1.3846
DIP	-0.0023	0.0116
TP	-0.0216	0.0380
TN	-0.0659	0.2261

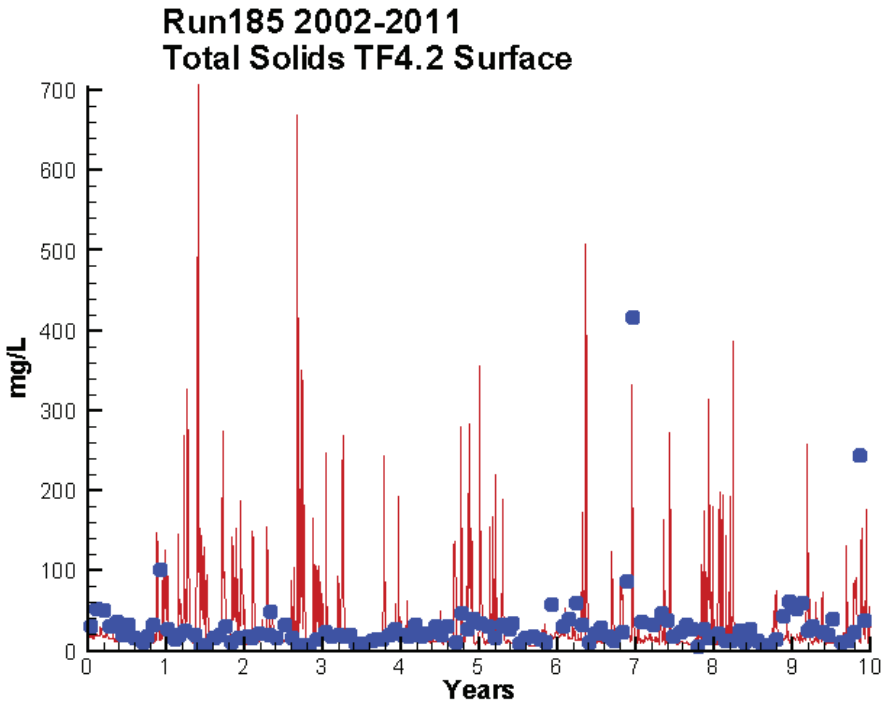
Station TF4.2

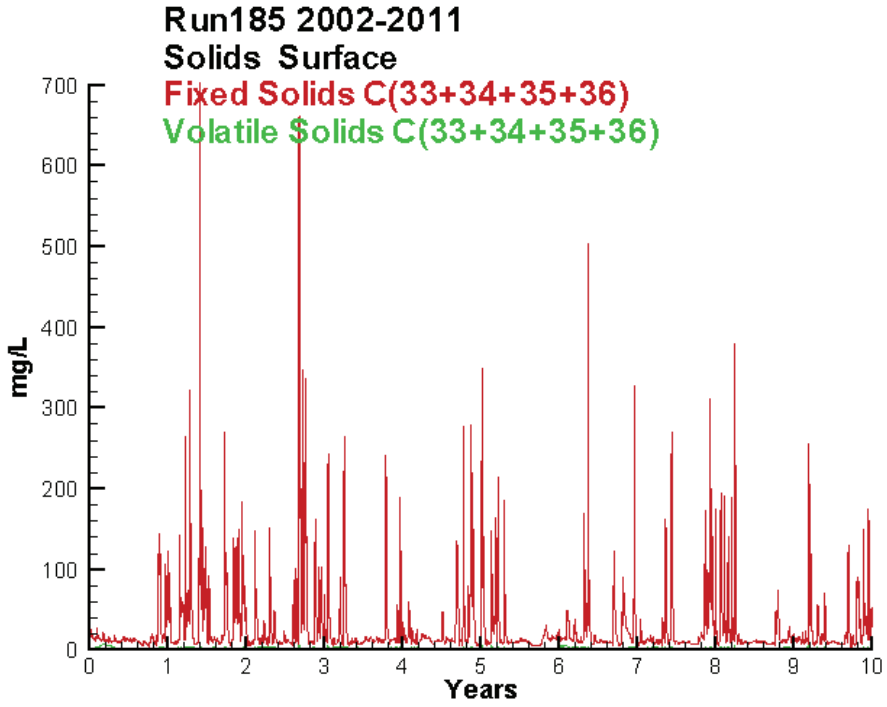


	Mean Difference	Absolute Mean Difference
Top DO	2.2185	2.2704

Station TF4.2

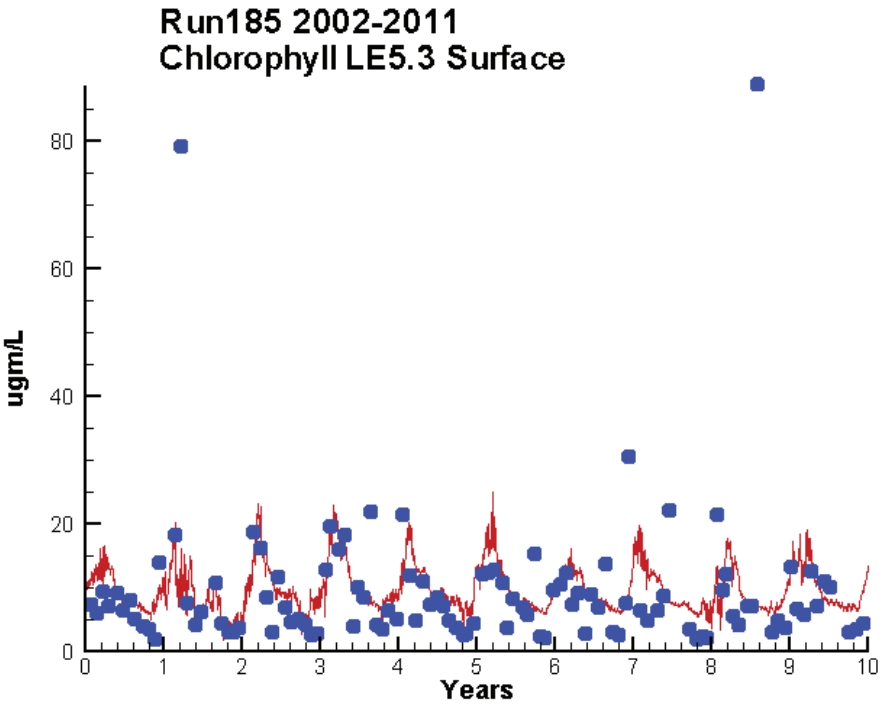


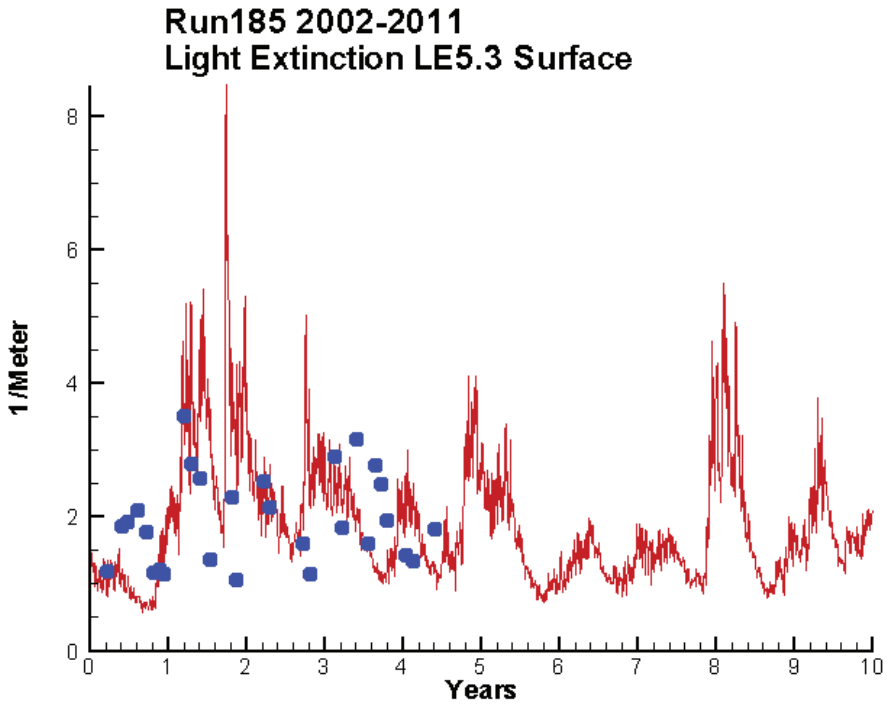


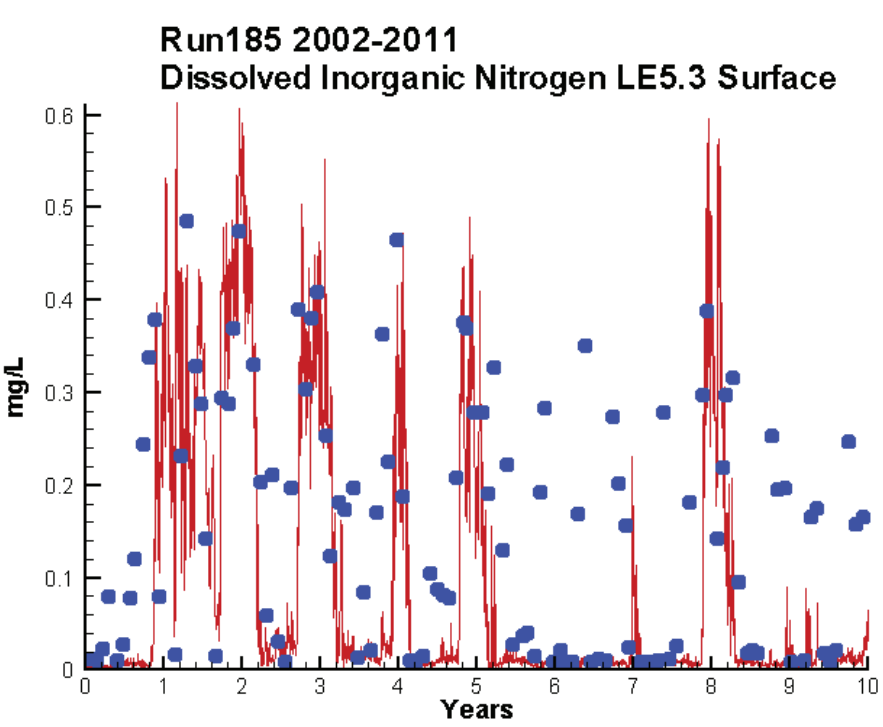


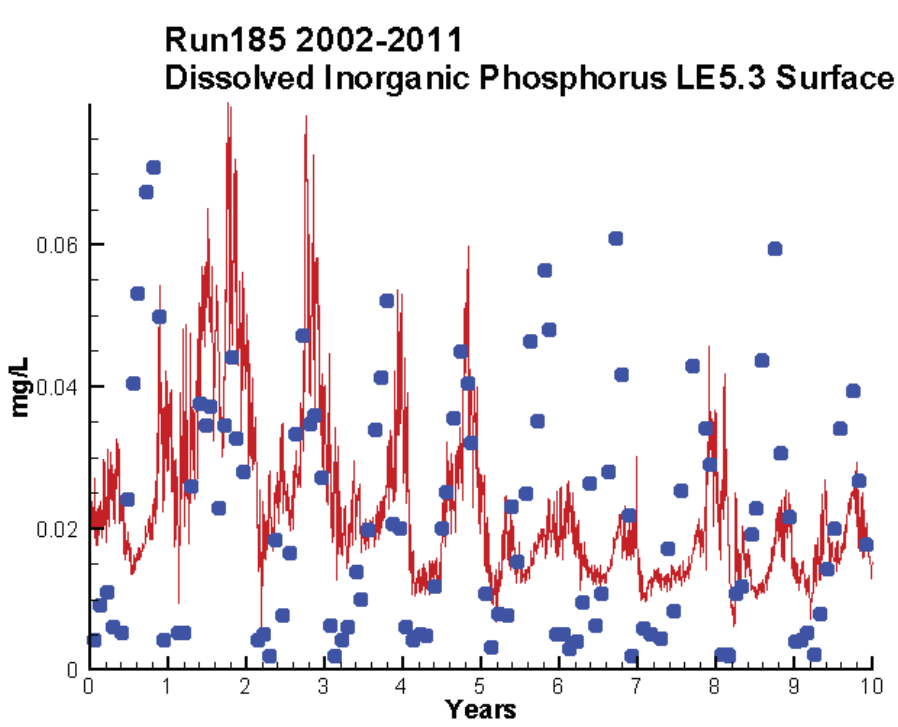
	Mean Difference	Absolute Mean Difference
KE	0.2348	1.3846
TSS	1.0171	29.1954

Station LE5.3

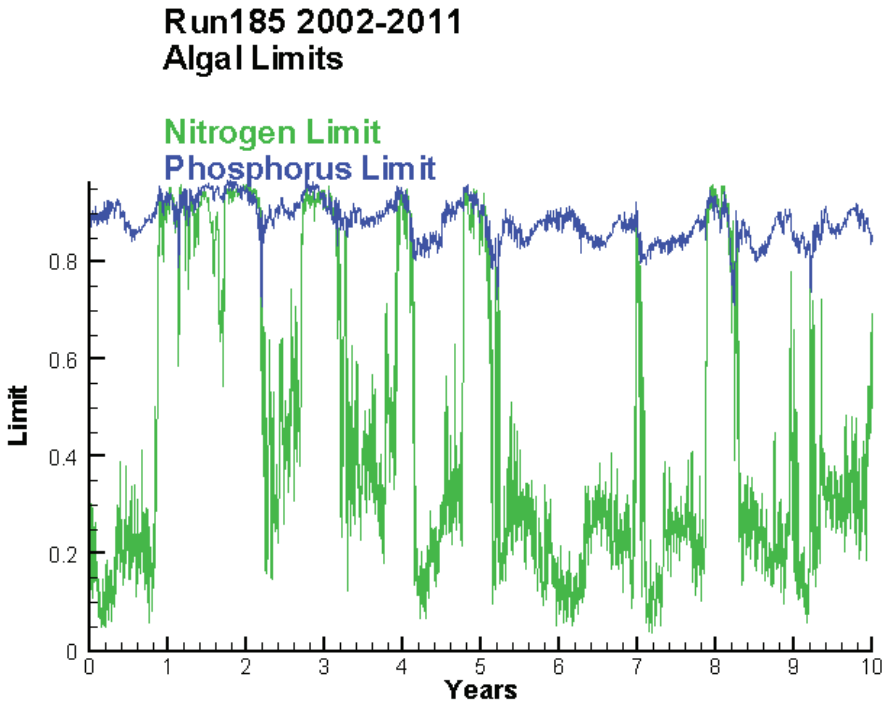


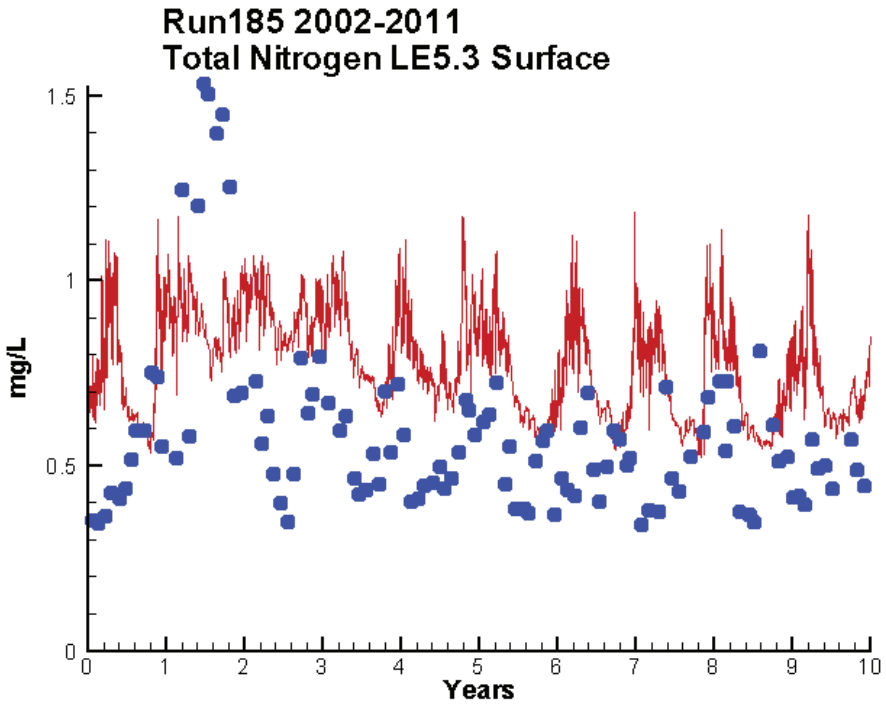


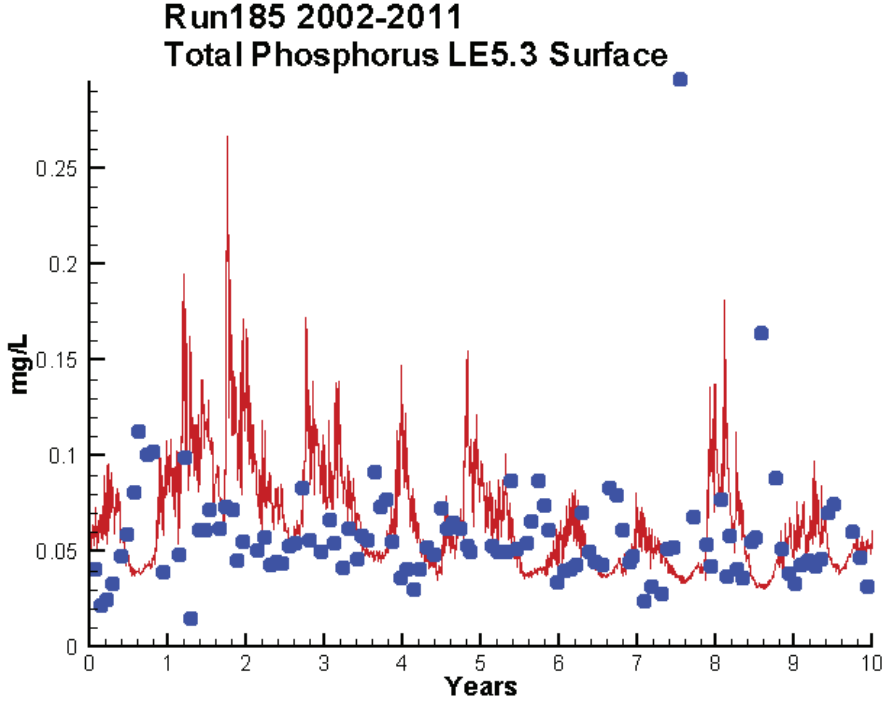




Station LE5.3

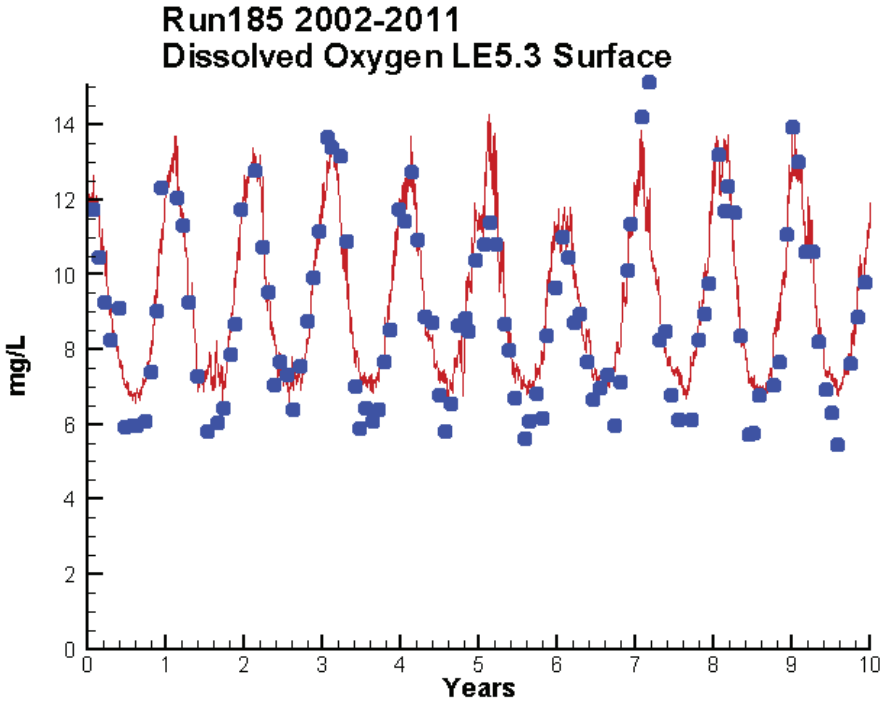


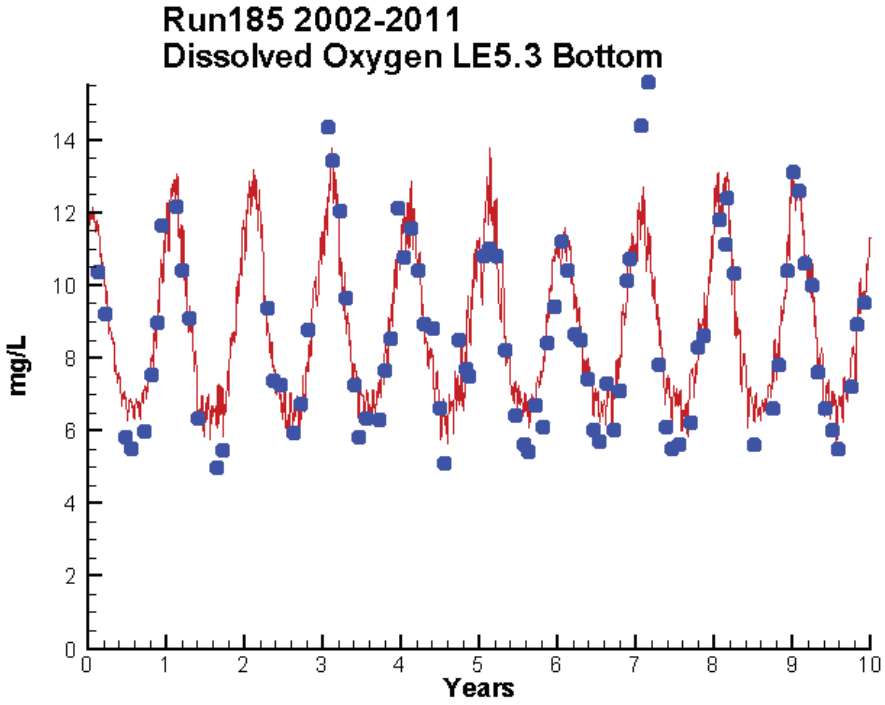


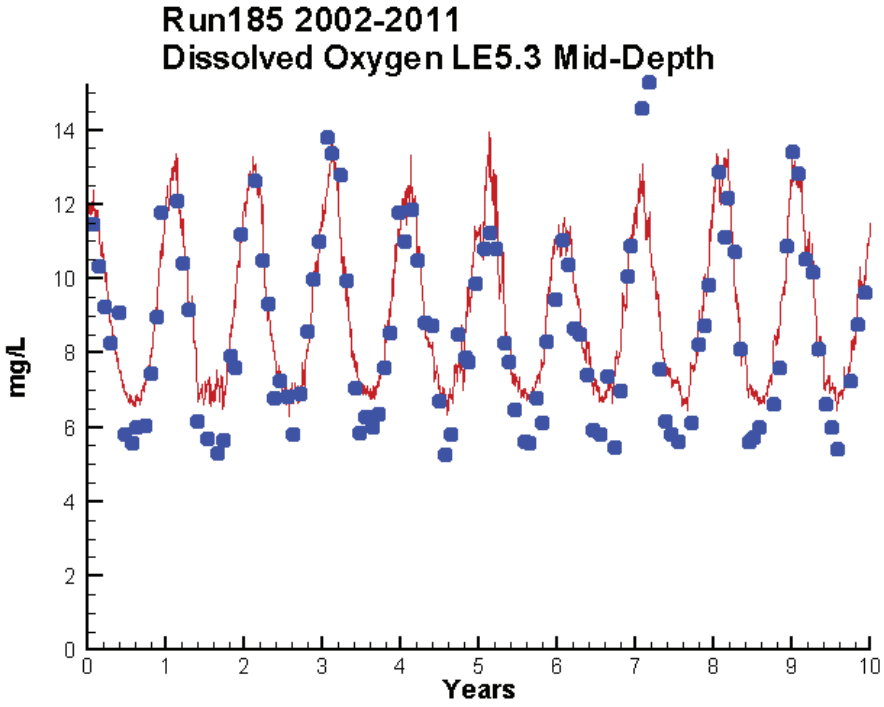


	Mean Difference	Absolute Mean Difference
Chl	0.3878	5.0631
DIN	-0.0686	0.0958
KE	0.1162	0.8436
DIP	0.0017	0.0136
TP	0.0082	0.0317
TN	0.1982	0.2706

Station LE5.3

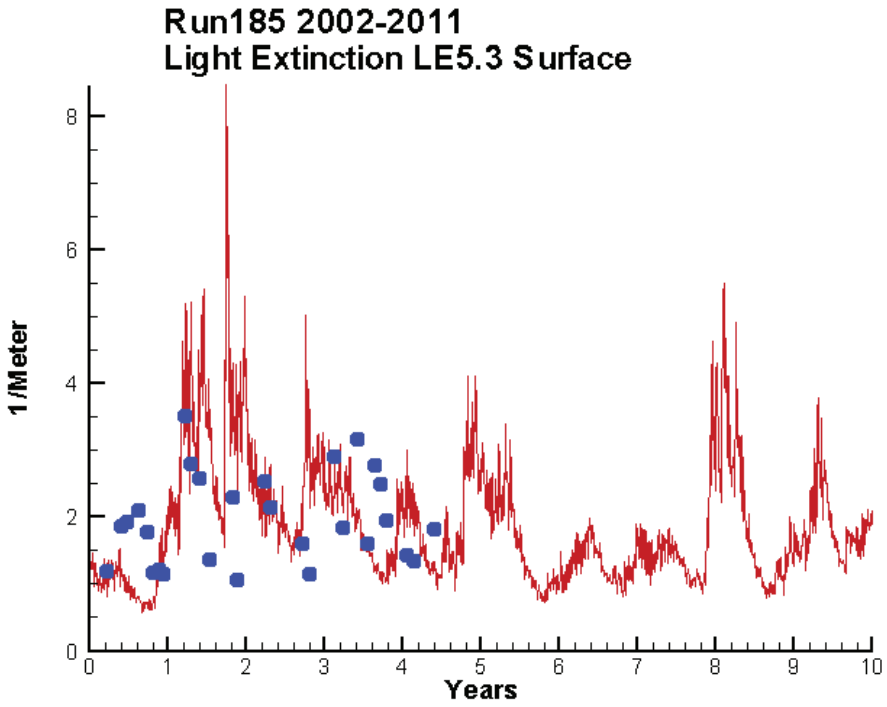


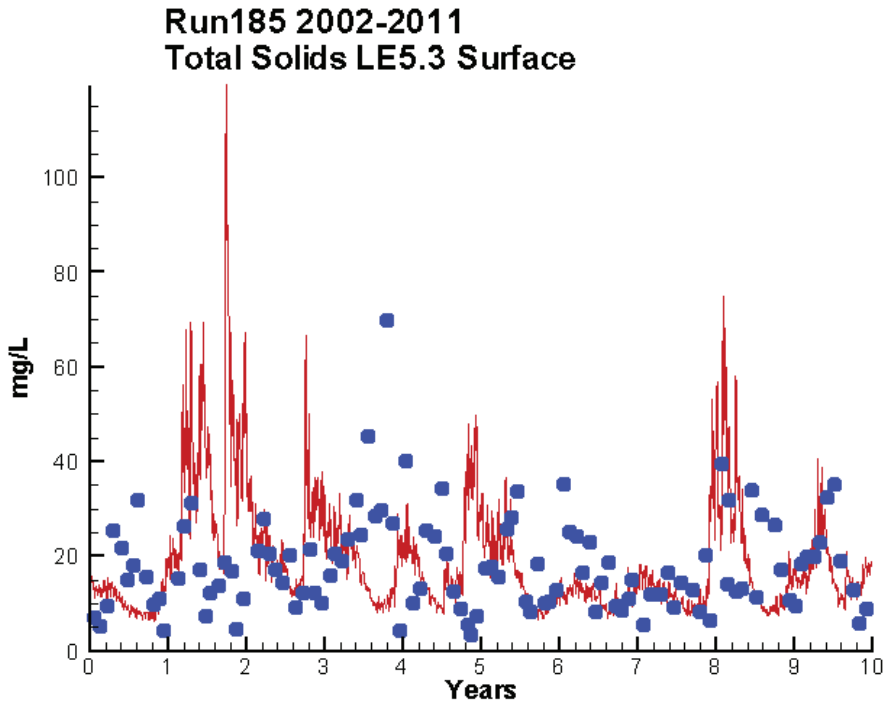


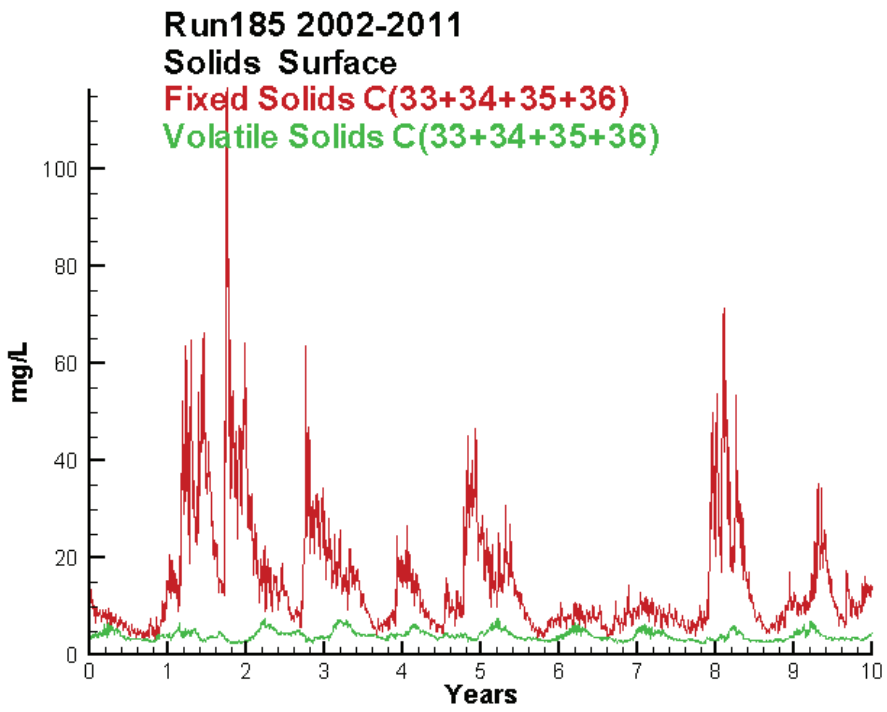


	Mean Difference	Absolute Mean Difference
Top DO	0.5121	0.8720
Mid DO	0.6263	0.9503
Bot DO	0.4136	0.8552

Station LE5.3

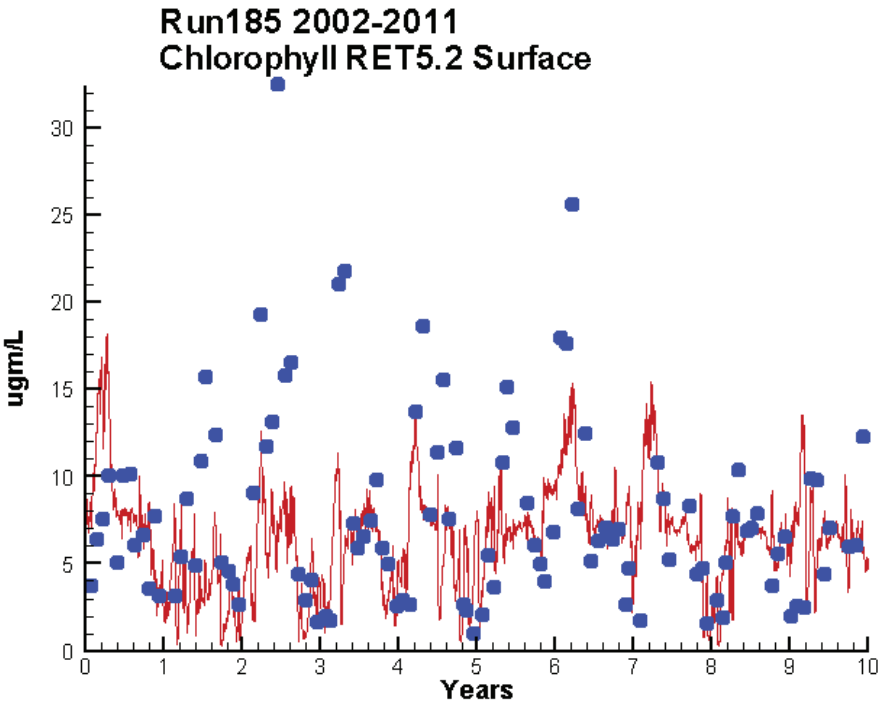


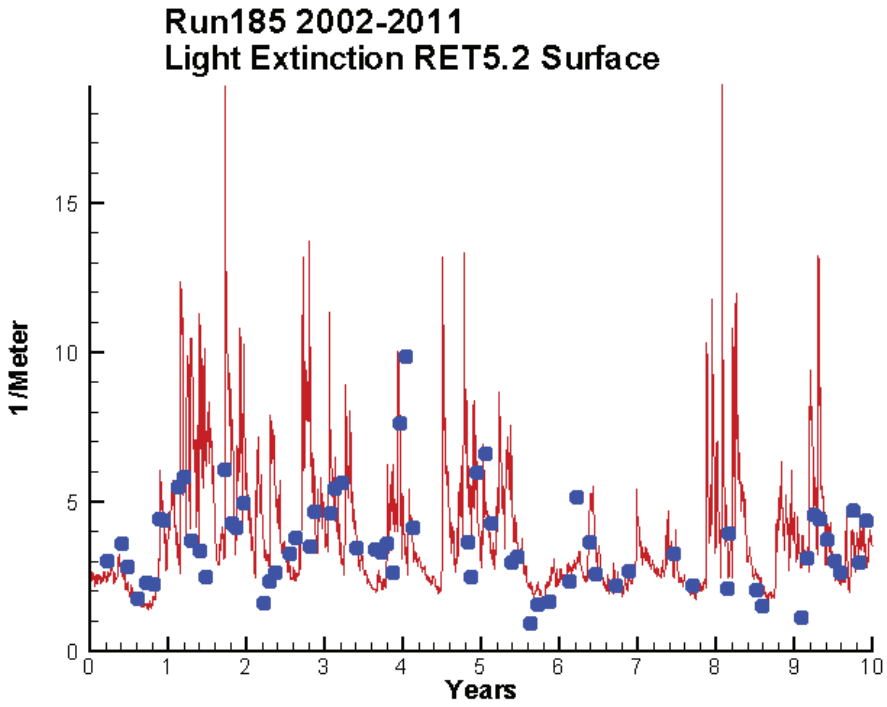


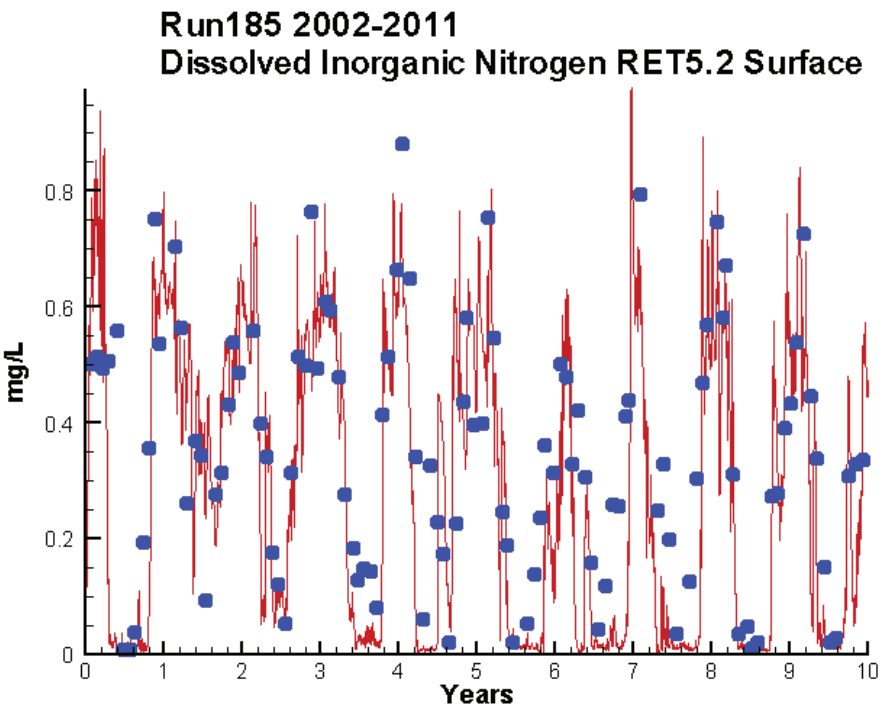


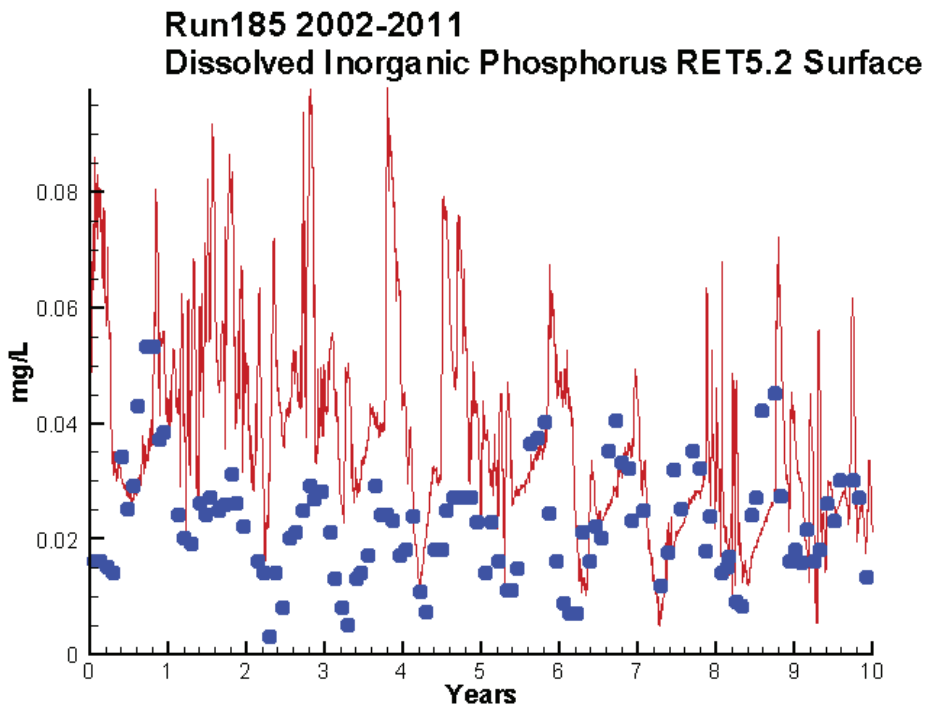
	Mean Difference	Absolute Mean Difference
KE	0.1162	0.8436
TSS	1.6267	11.5137

Station RET5.2

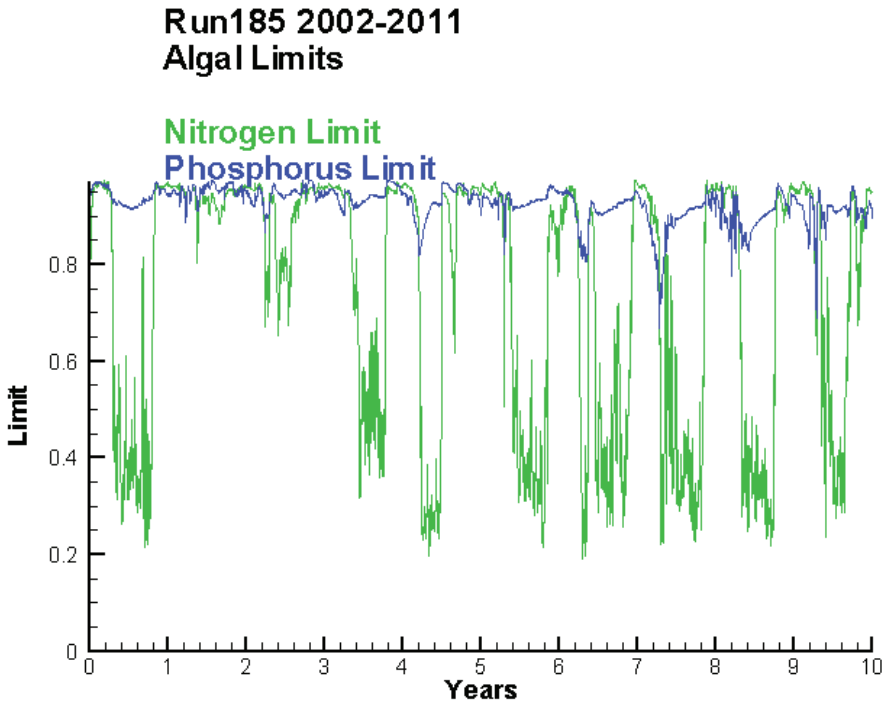


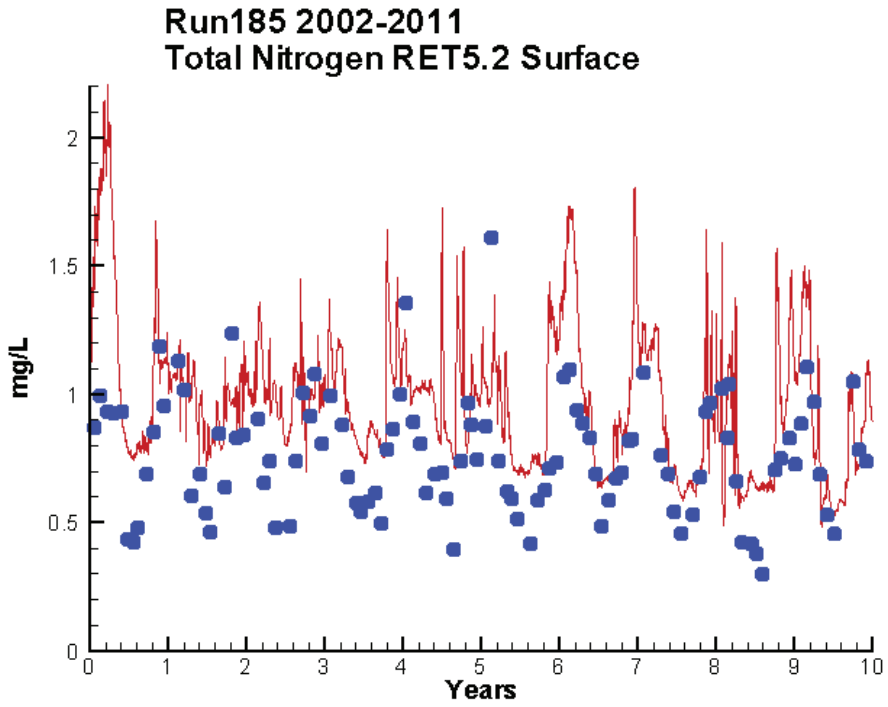


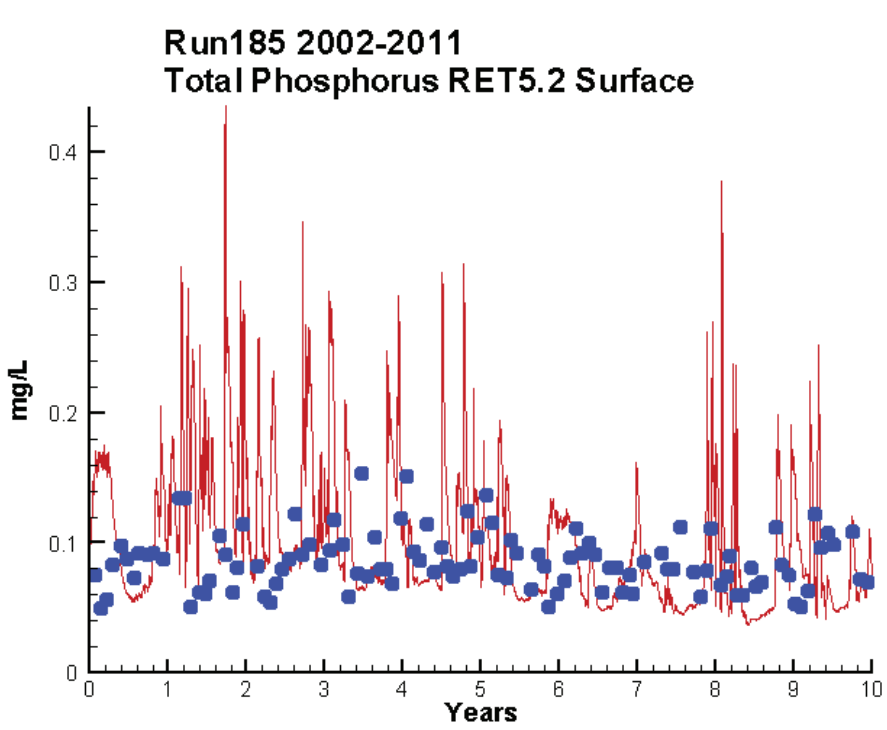




Station RET5.2

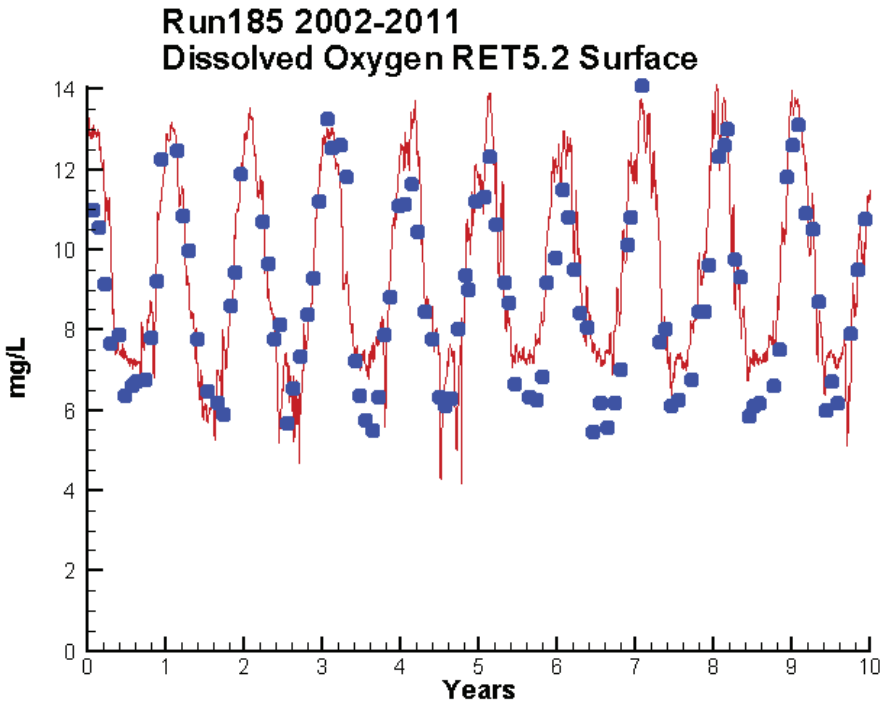


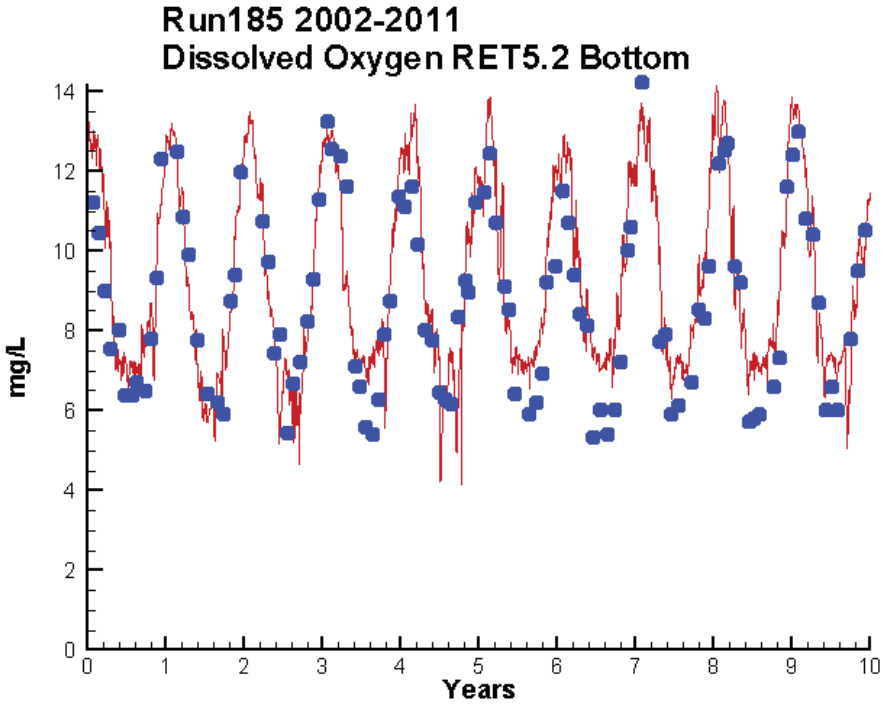




	Mean Difference	Absolute Mean Difference
Chl	-1.2059	3.8493
DIN	-0.0509	0.1343
KE	0.5825	1.6815
DIP	0.0166	0.0196
TP	0.0236	0.0494
TN	0.2457	0.2796

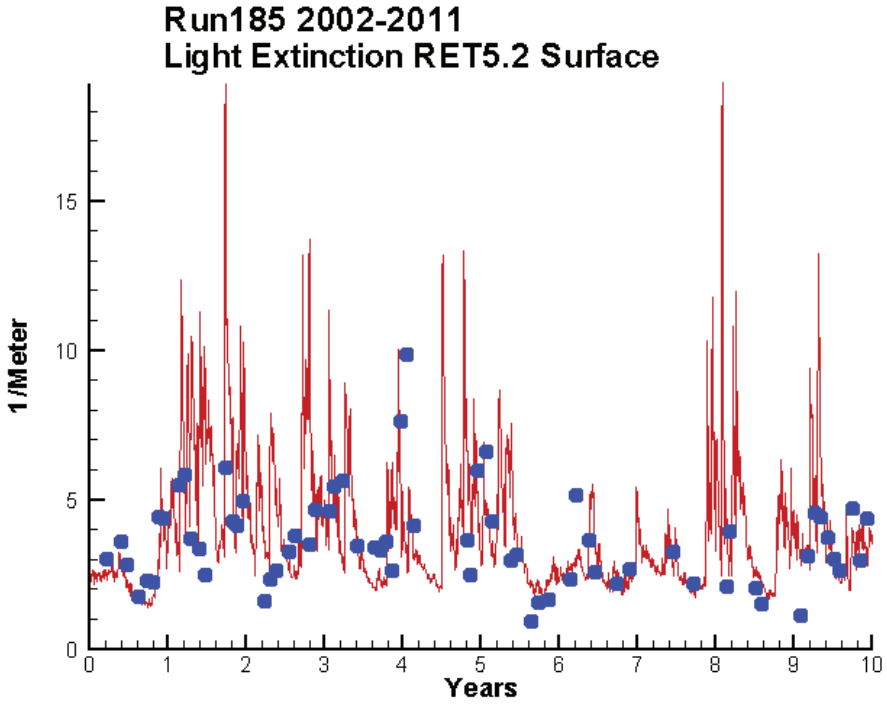
Station RET5.2

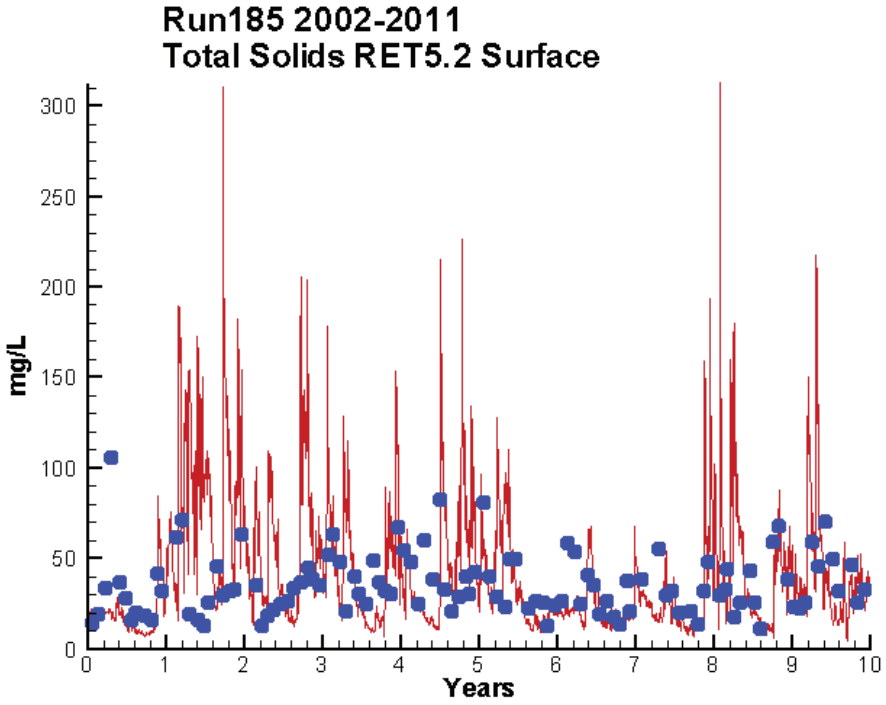


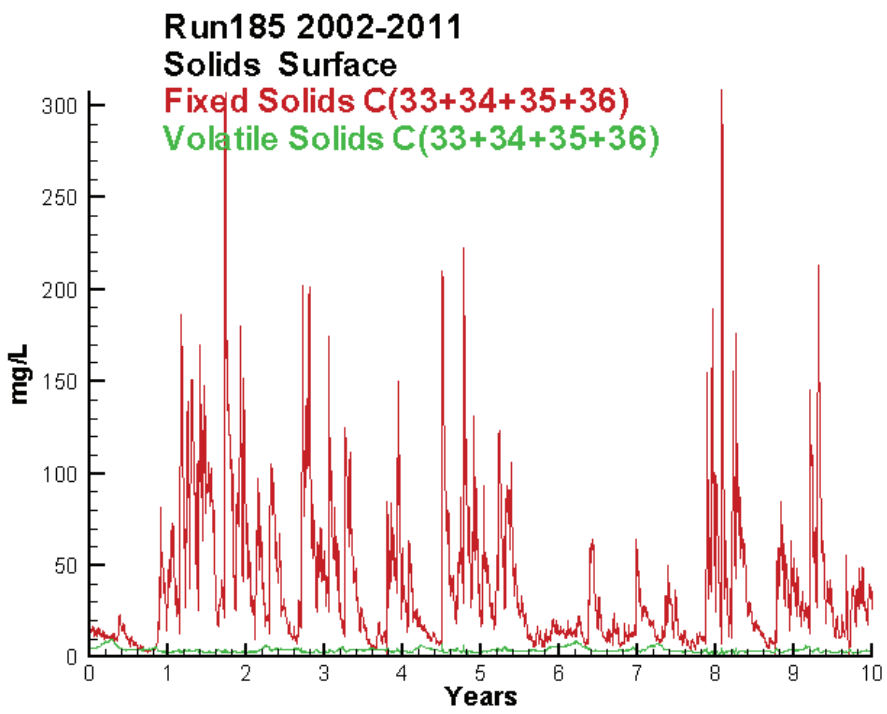


	Mean Difference	Absolute Mean Difference
Top DO	0.6359	1.0669
Bot DO	0.6132	1.0438

Station RET5.2

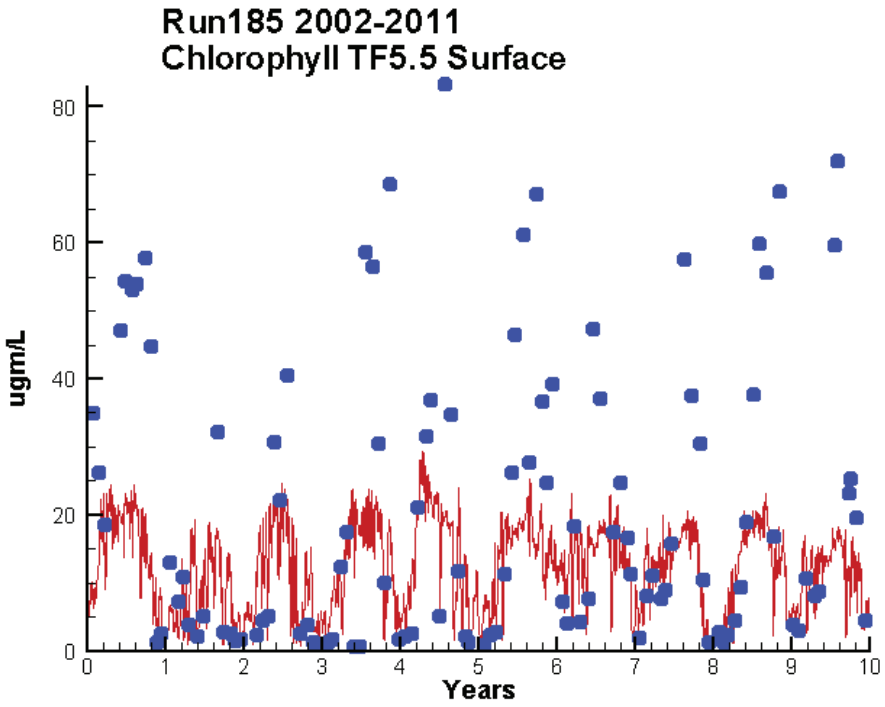


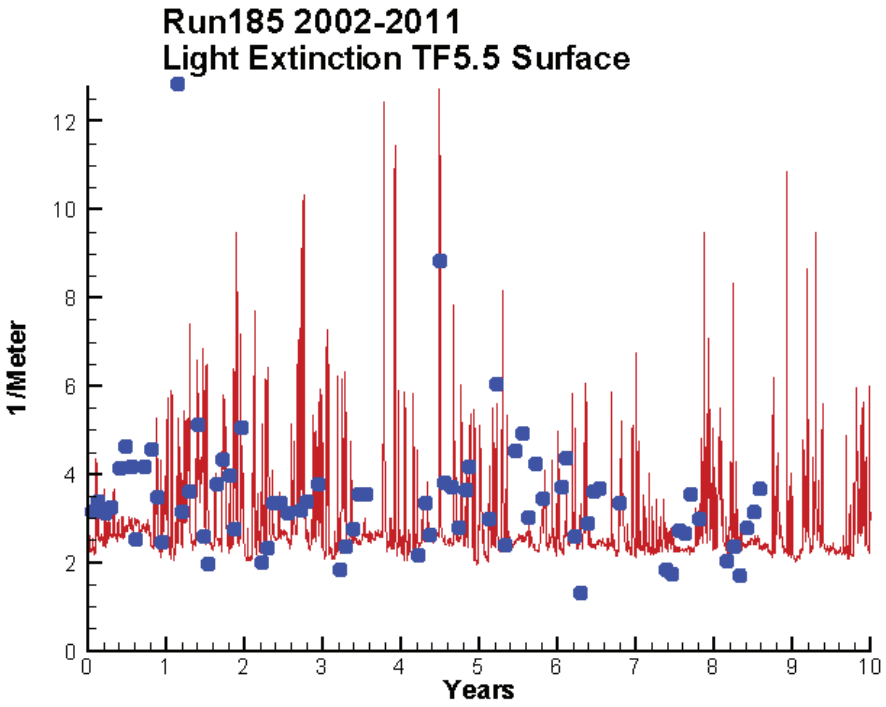


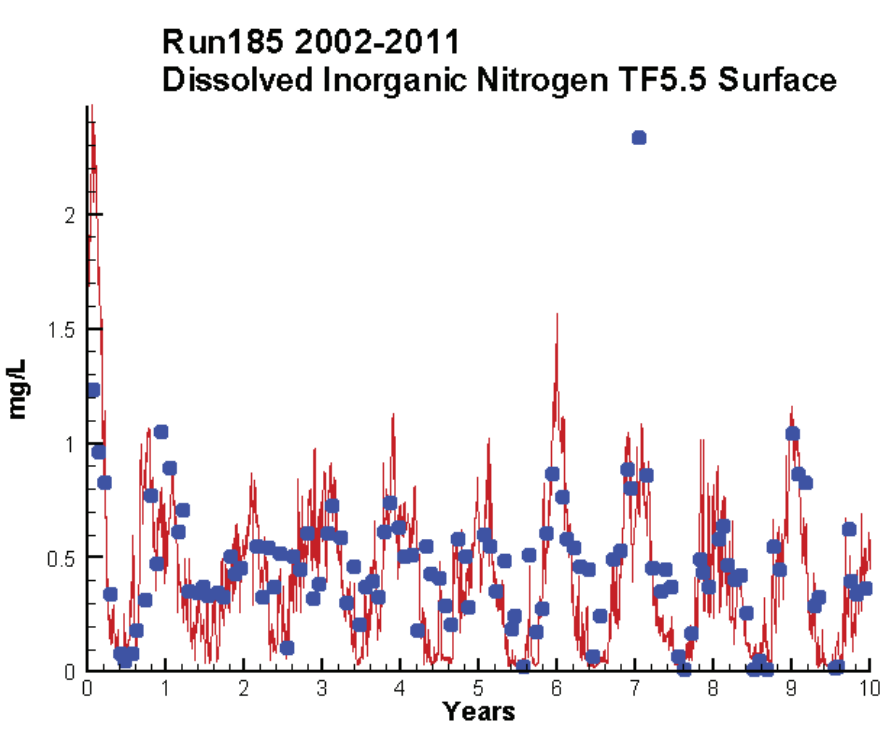


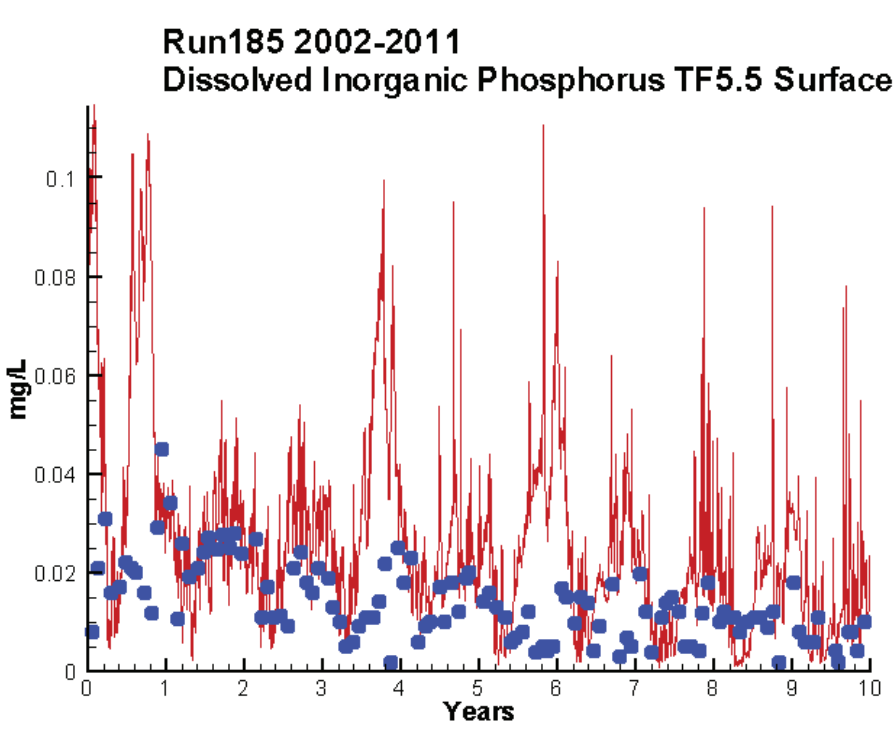
	Mean Difference	Absolute Mean Difference
KE	0.5825	1.6815
TSS	11.7786	30.2895

Station TF5.5

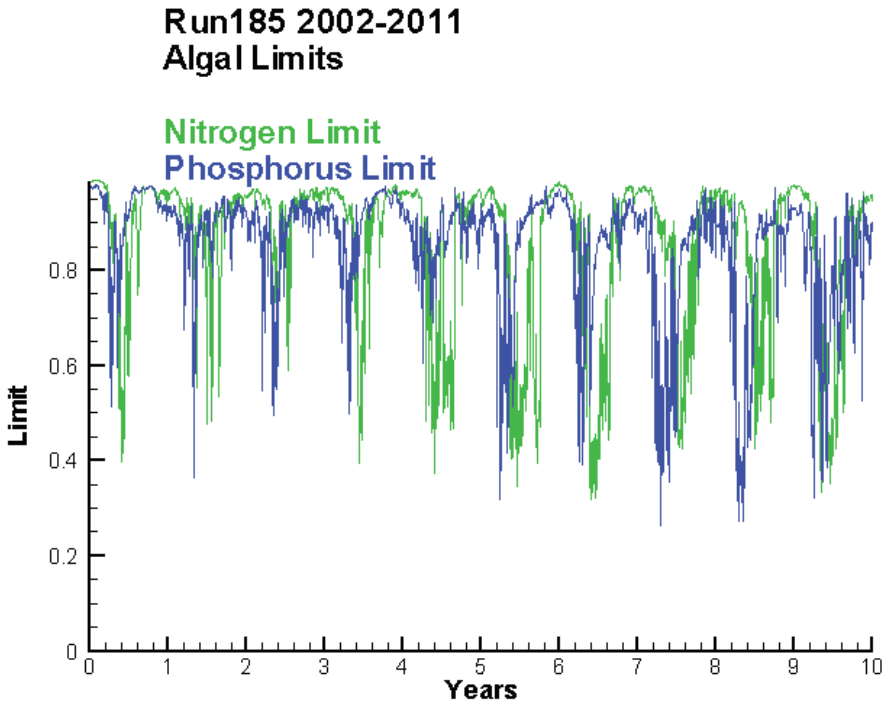


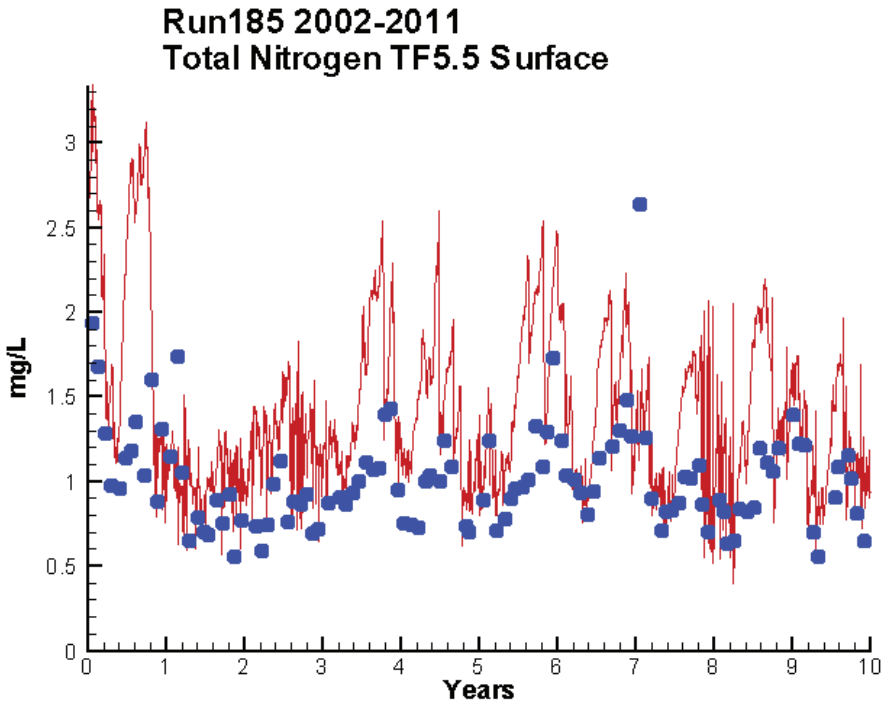


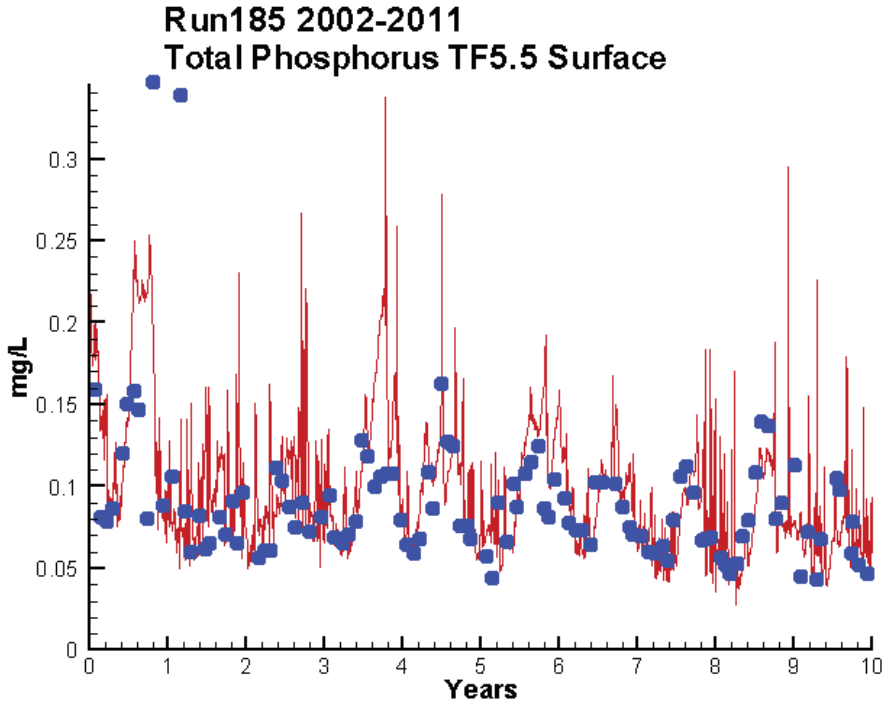




Station TF5.5

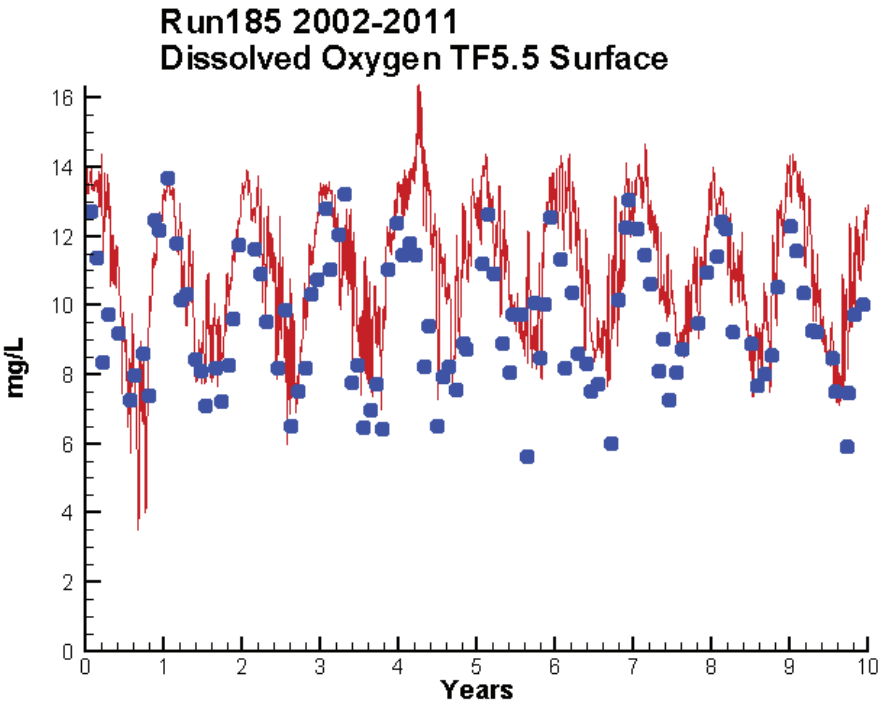






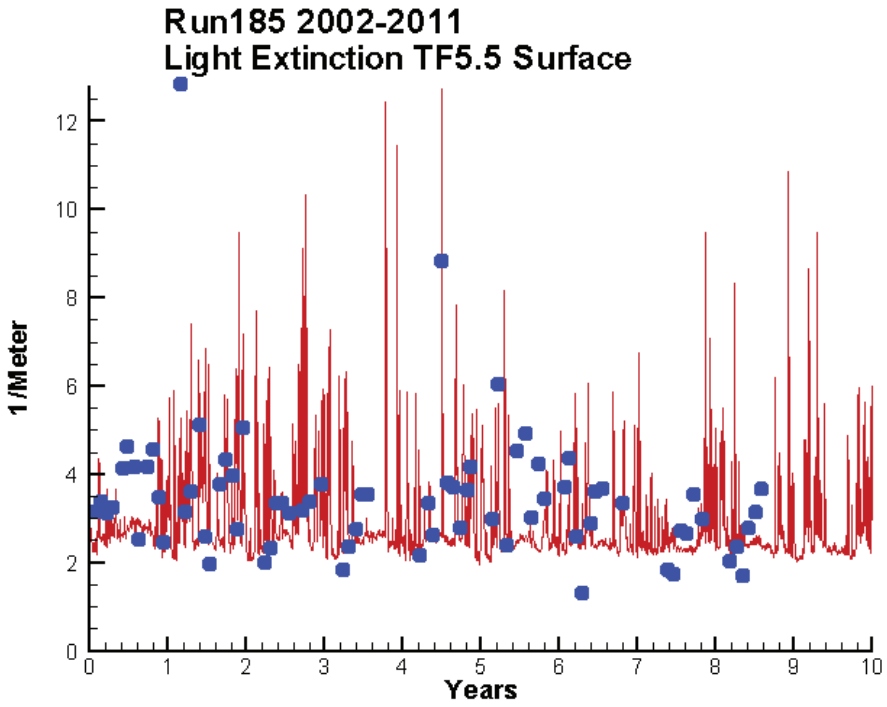
	Mean Difference	Absolute Mean Difference
Chl	-8.8161	13.2715
DIN	-0.0364	0.1762
KE	-0.3434	1.0290
DIP	0.0135	0.0160
TP	0.0120	0.0296
TN	0.4223	0.4691

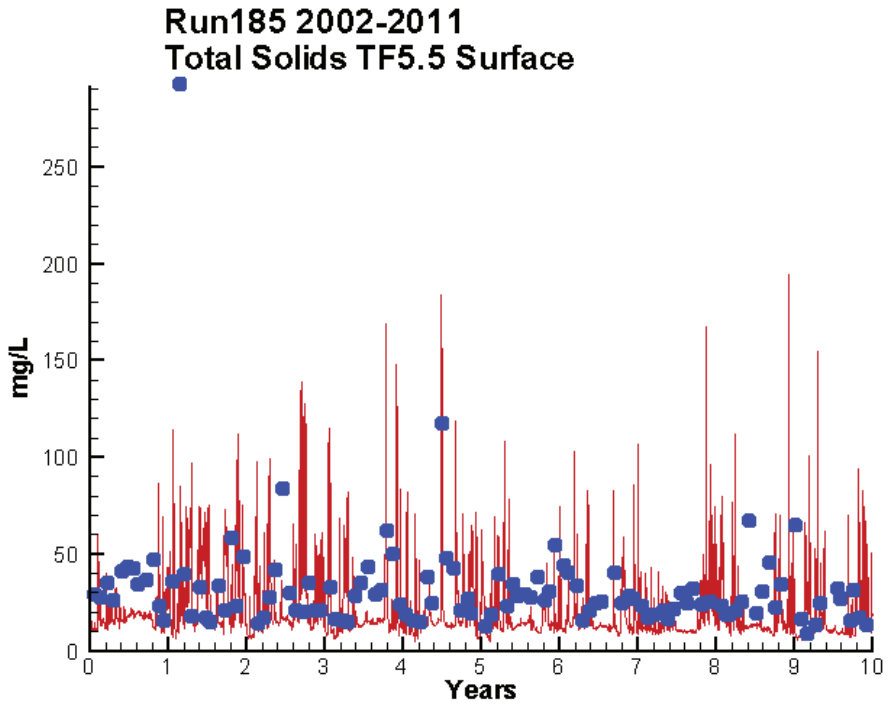
Station TF5.5

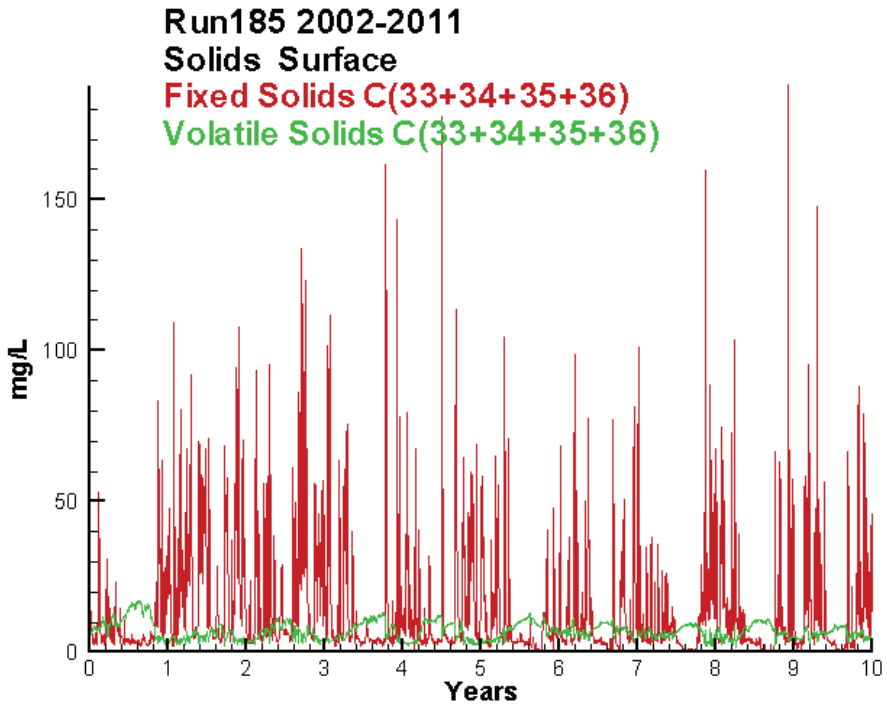


	Mean Difference	Absolute Mean Difference
Top DO	1.6069	1.7413

Station TF5.5

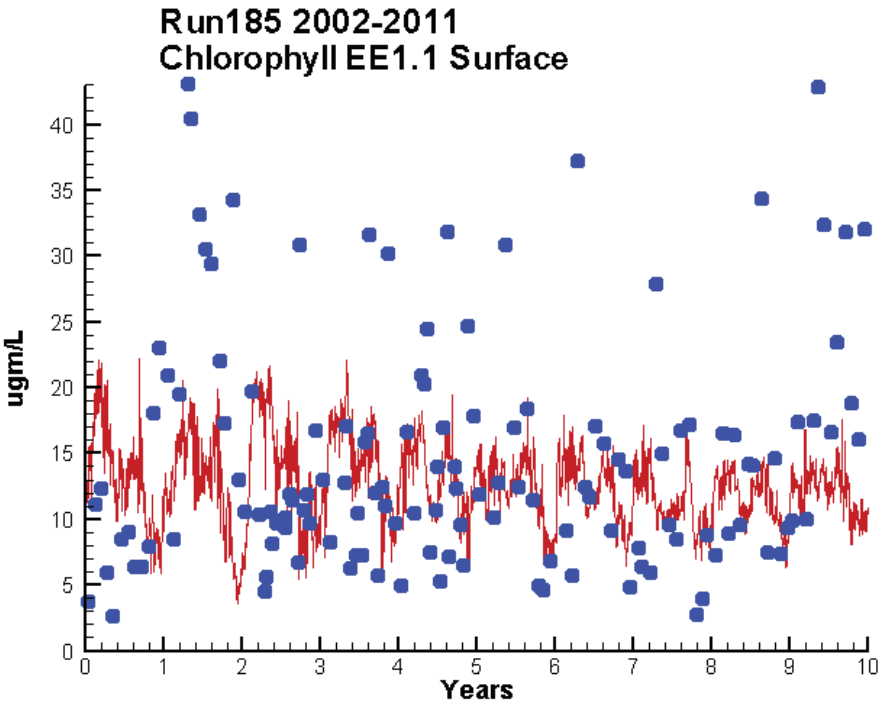


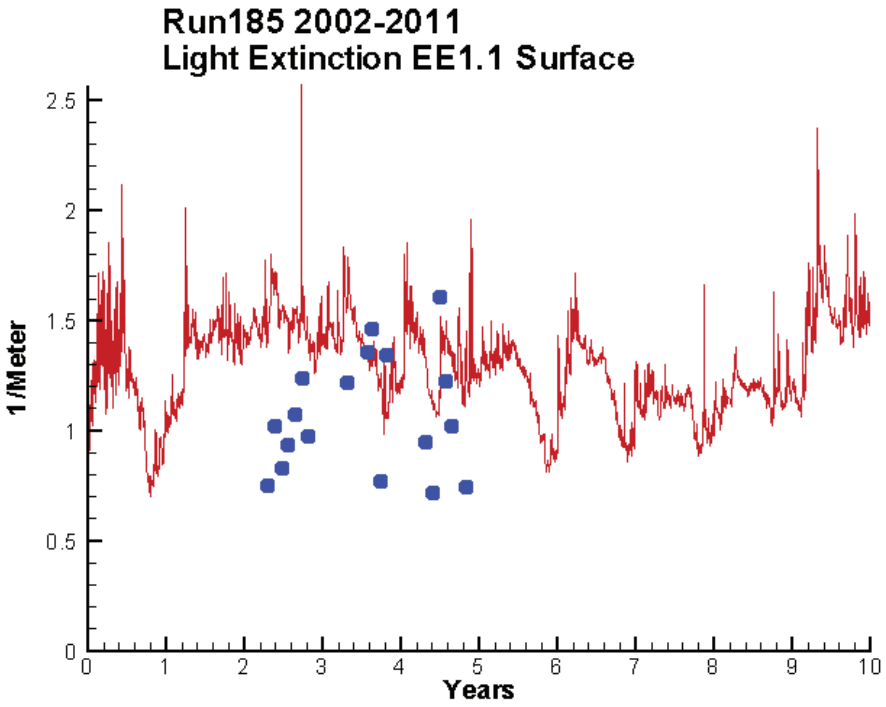


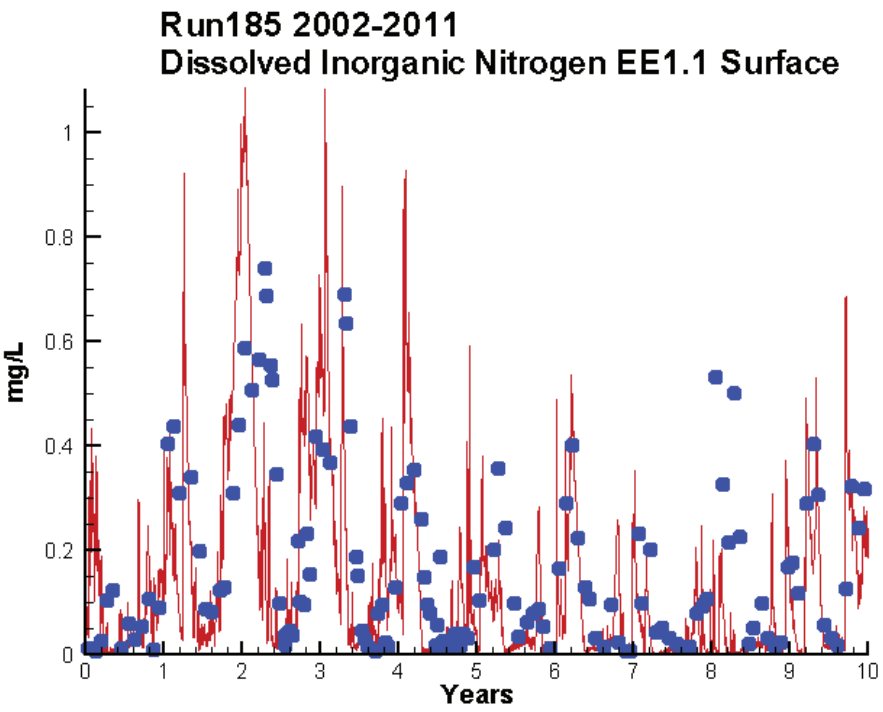


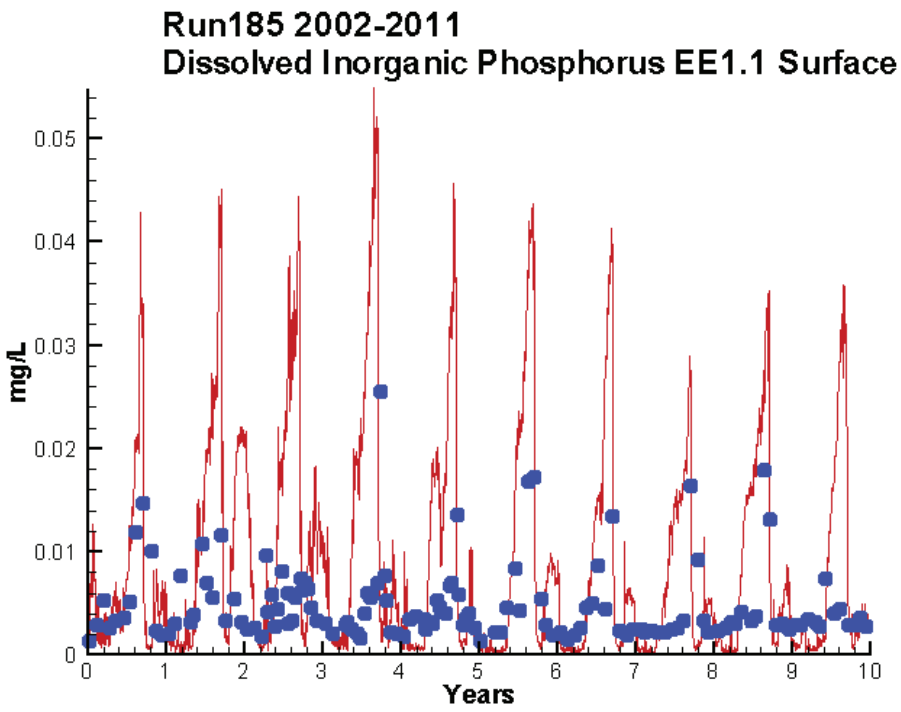
	Mean Difference	Absolute Mean Difference
KE	-0.3434	1.0290
TSS	-8.4295	21.1587

Station EE1.1

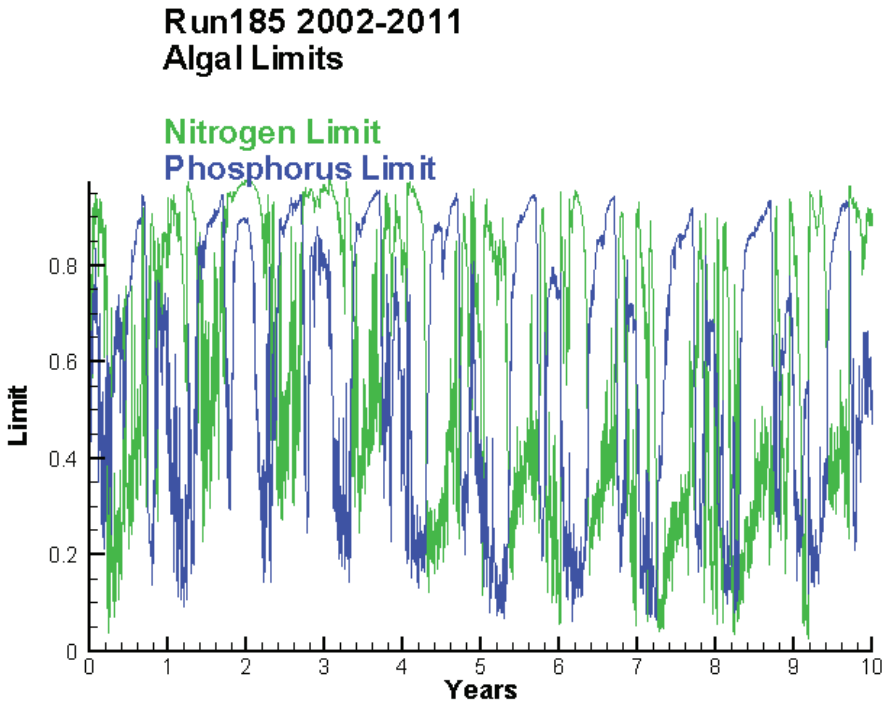


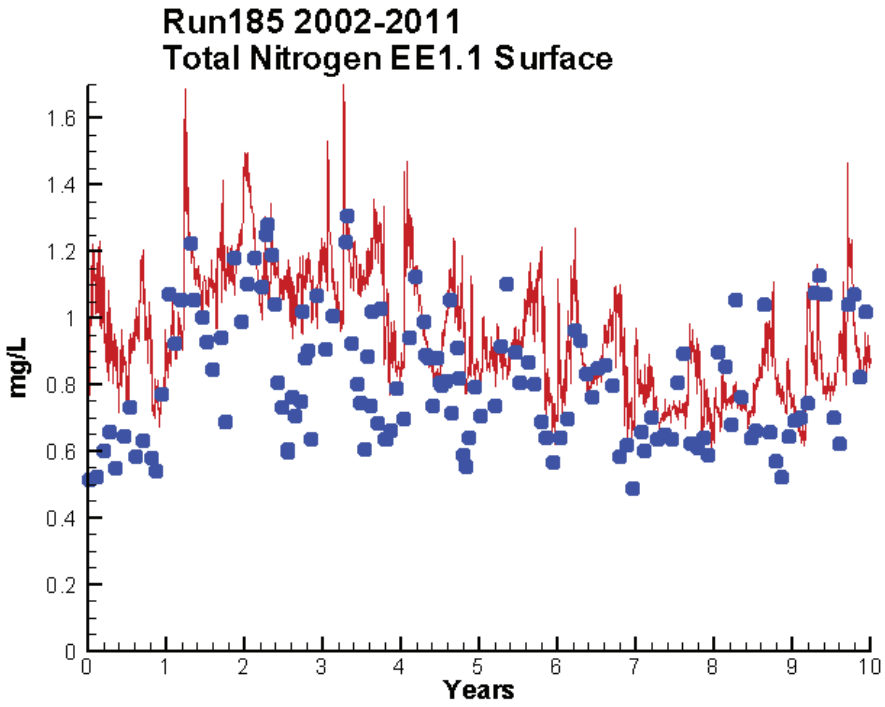


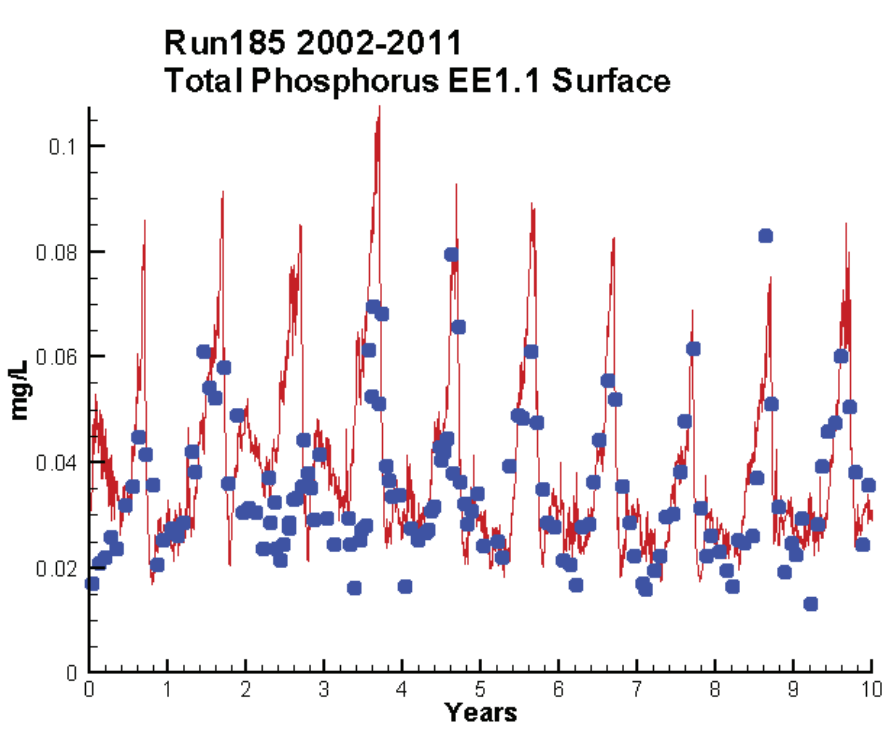




Station EE1.1

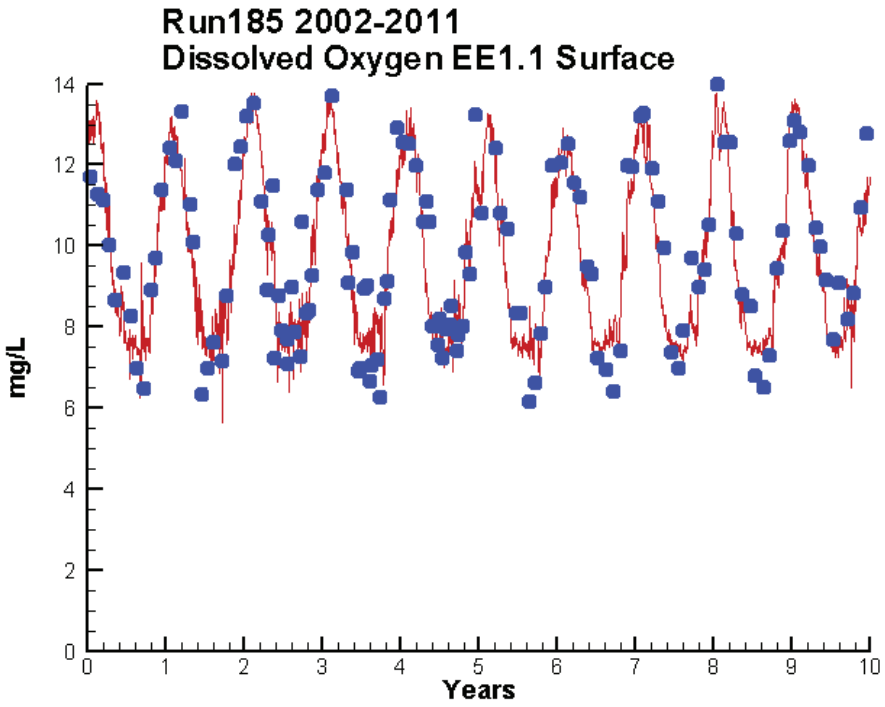


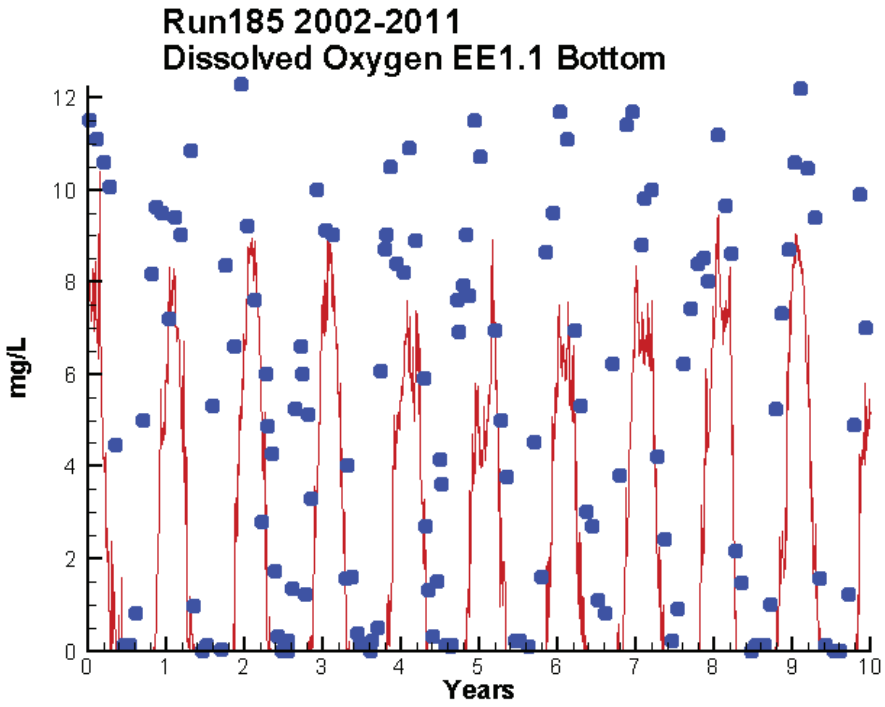


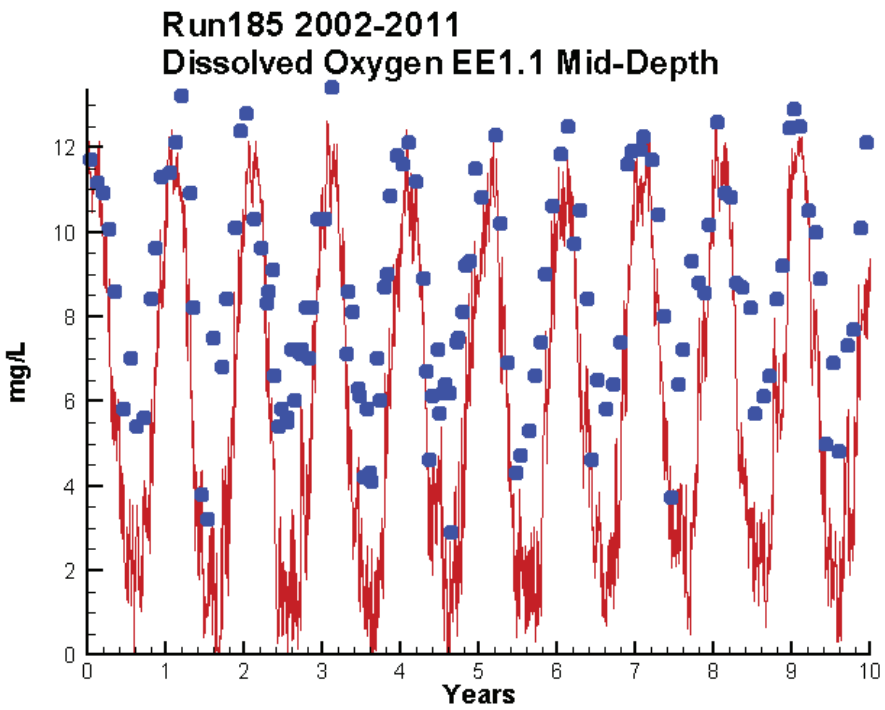


	Mean Difference	Absolute Mean Difference
Chl	-1.8408	7.1310
DIN	-0.0419	0.1275
KE	0.4815	0.5739
DIP	0.0046	0.0074
TP	0.0051	0.0109
TN	0.1457	0.1946

Station EE1.1

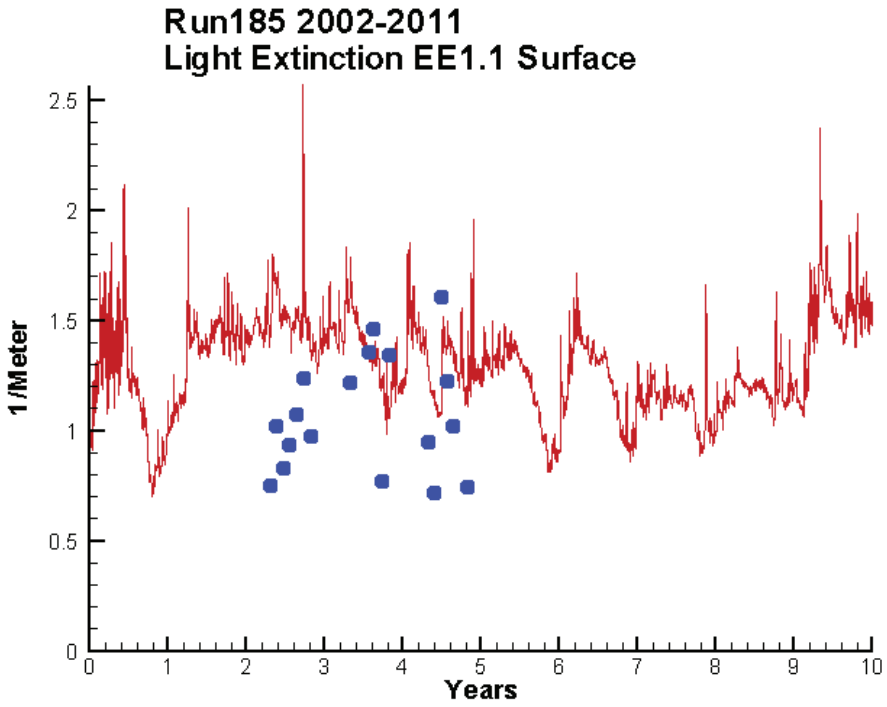


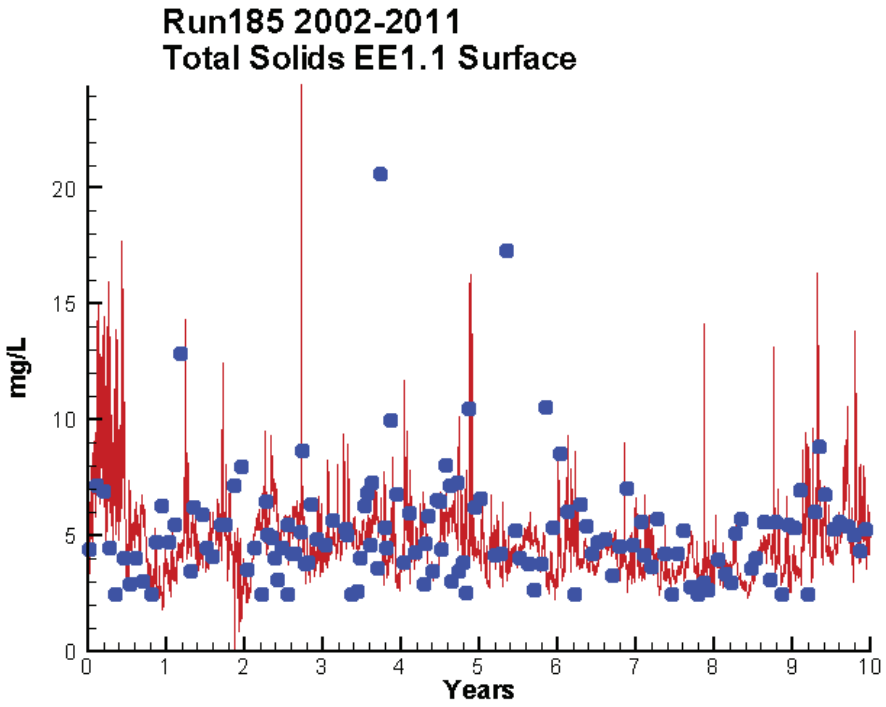


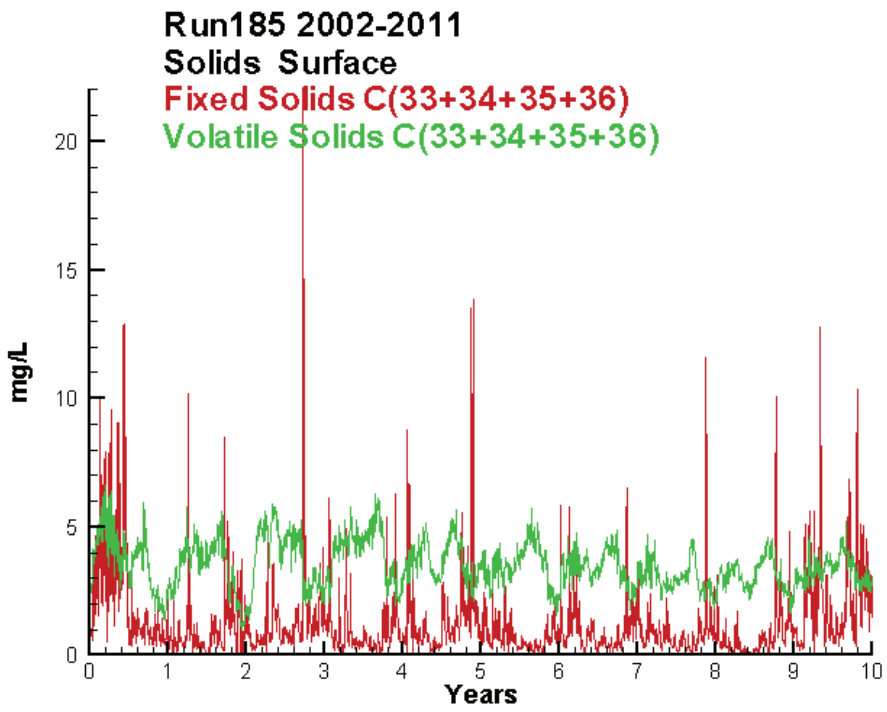


	Mean Difference	Absolute Mean Difference
Top DO	-0.1693	0.7751
Mid DO	-2.7728	2.8139
Bot DO	-3.2444	3.2900

Station EE1.1

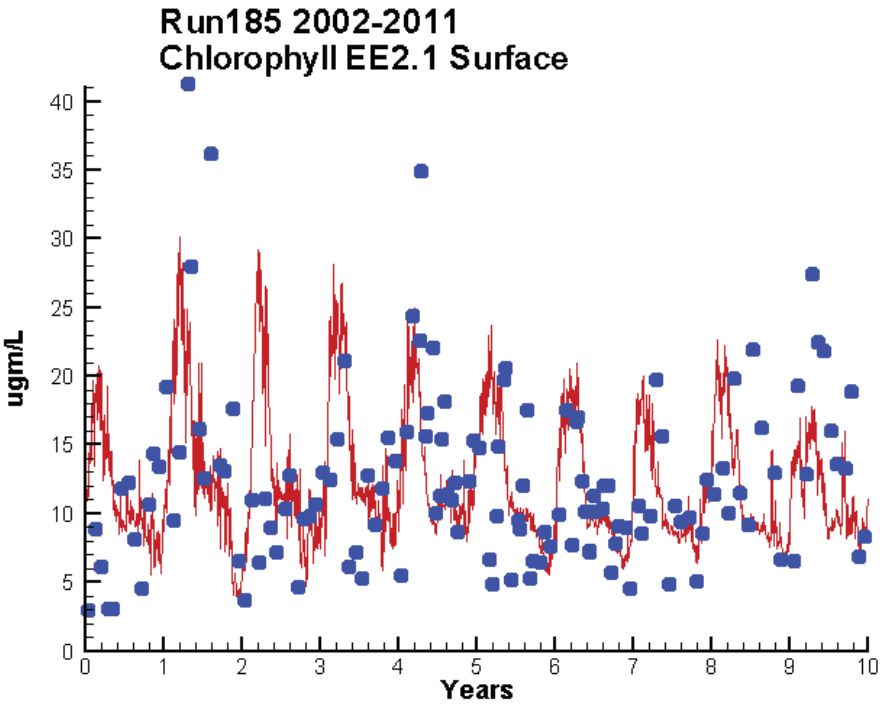


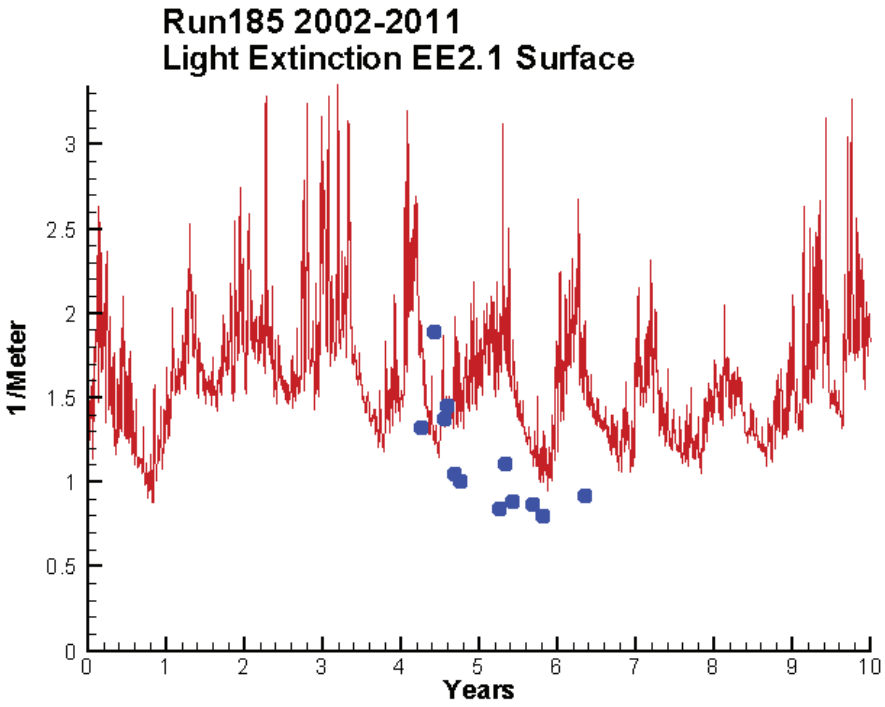


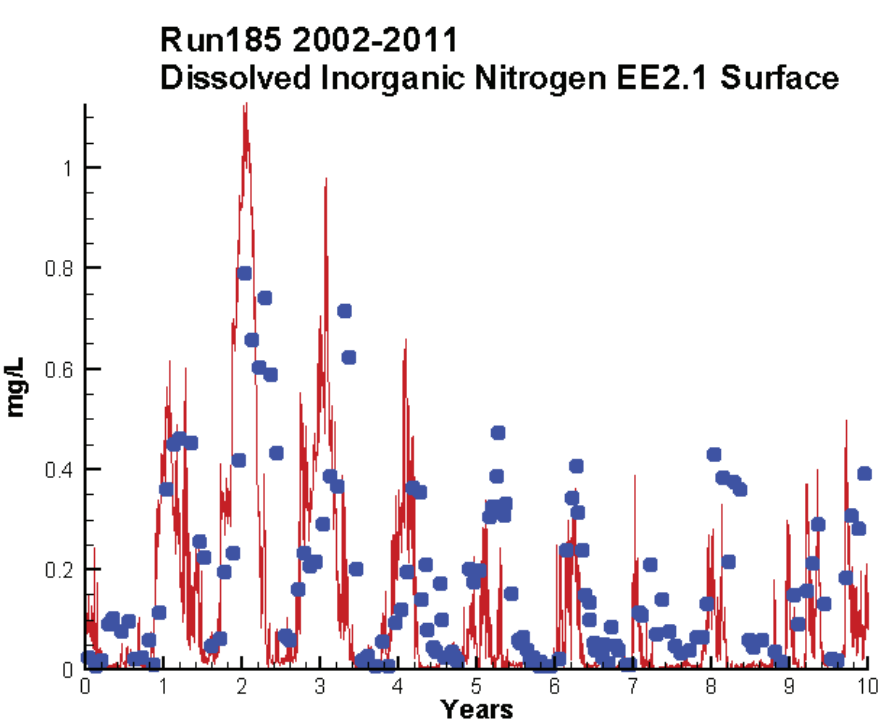


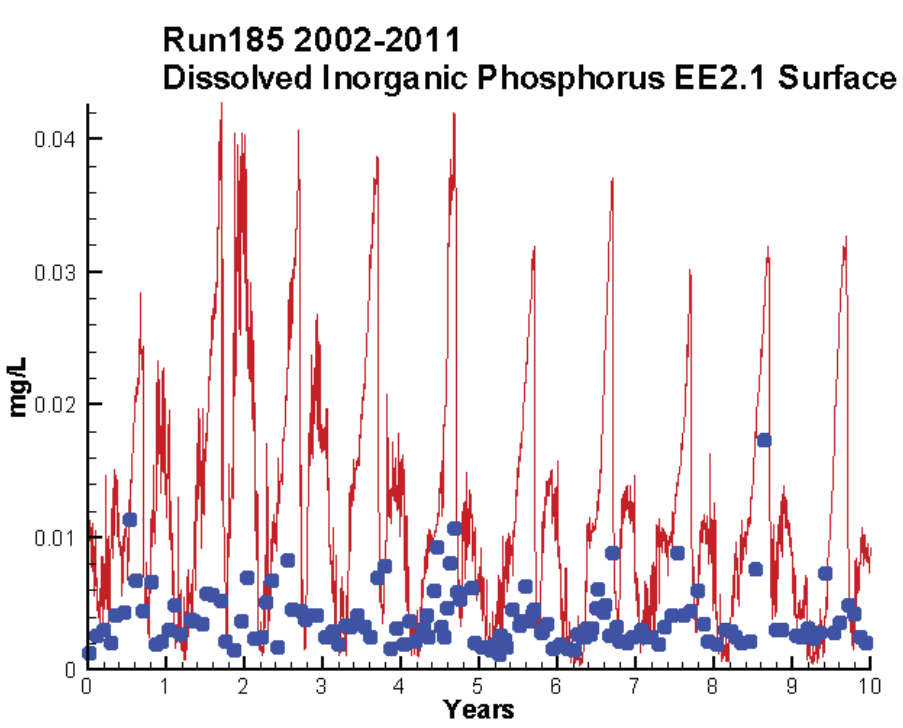
	Mean Difference	Absolute Mean Difference
KE	0.4815	0.5739
TSS	-0.2391	2.1513

Station EE2.1

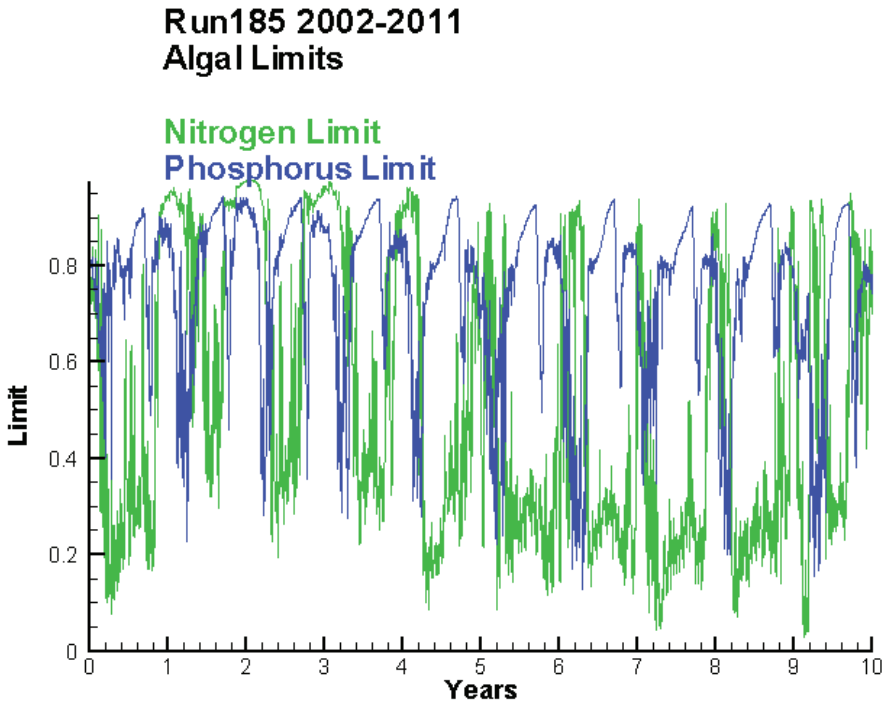


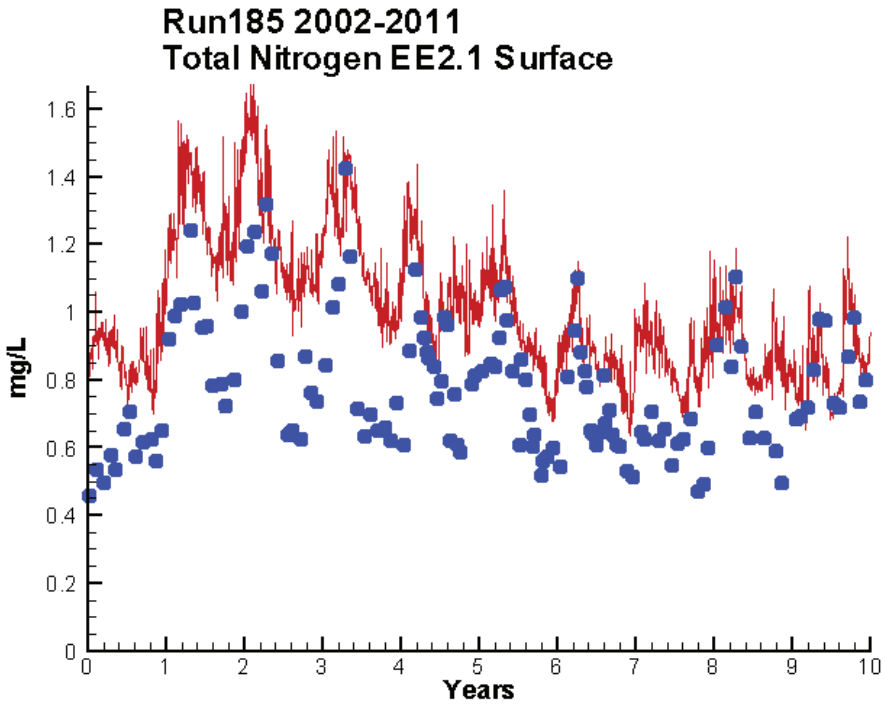


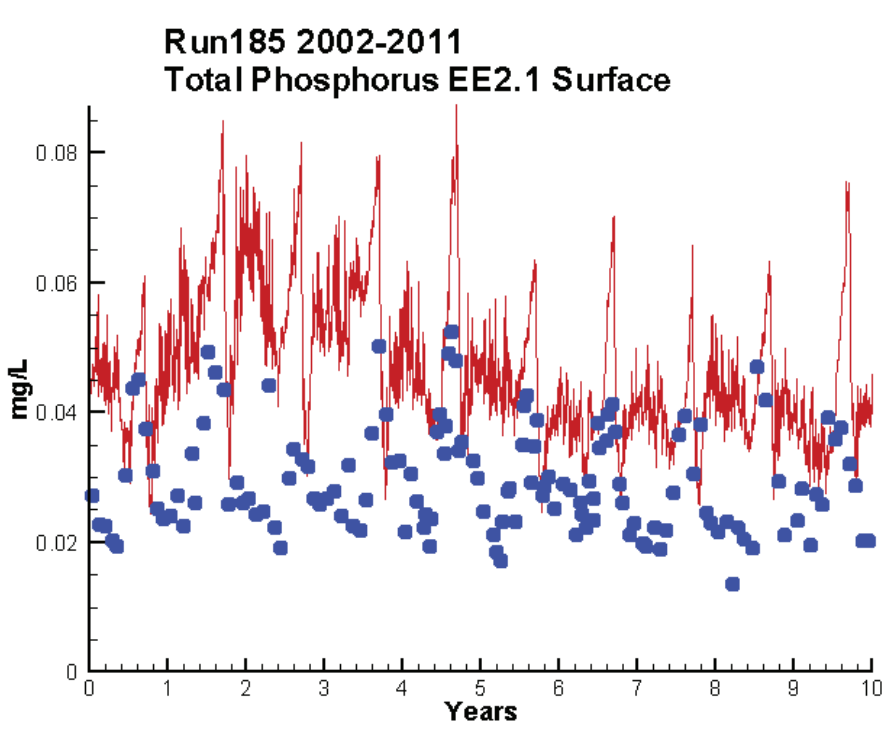




Station EE2.1

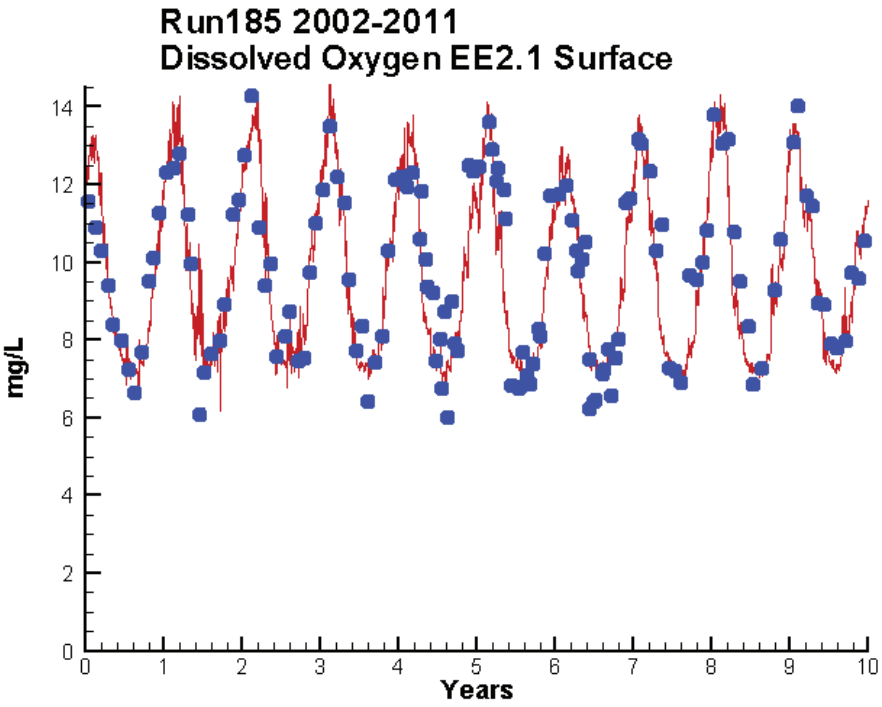


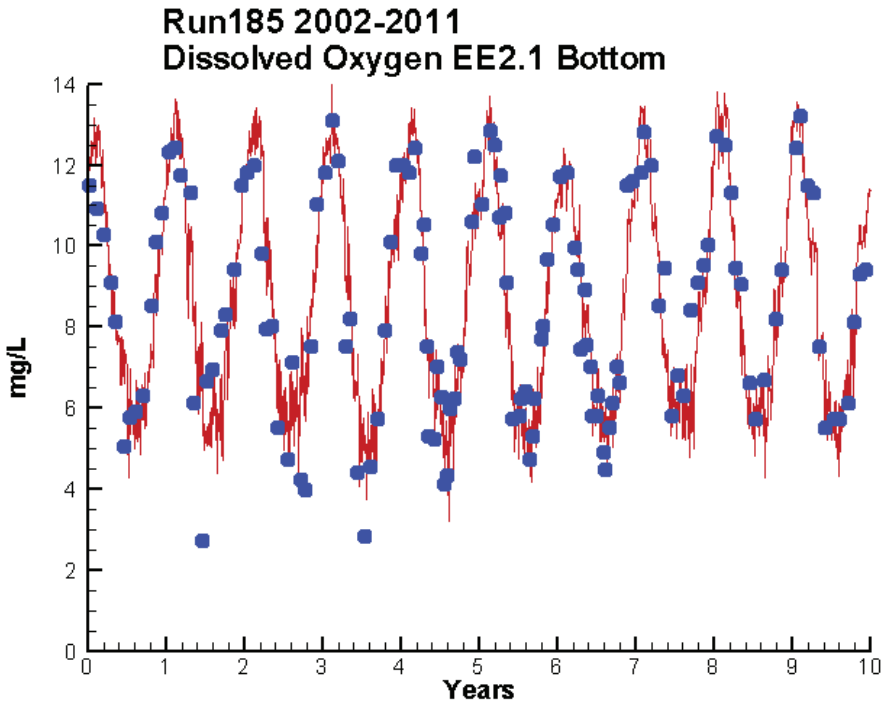


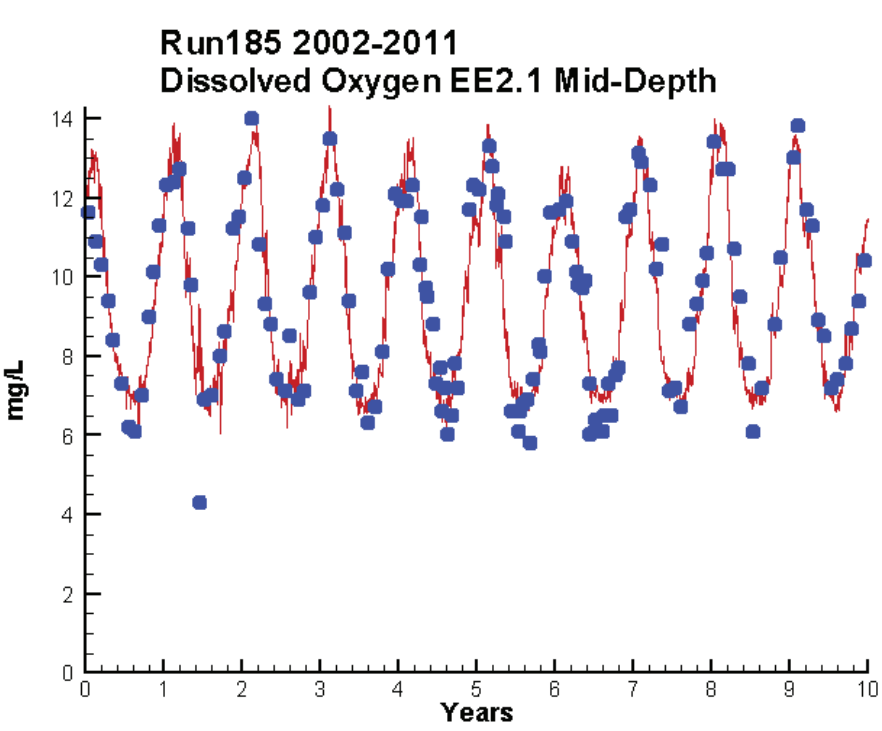


	Mean Difference	Absolute Mean Difference
Chl	0.0791	5.1238
DIN	-0.0661	0.1273
KE	0.3670	0.4848
DIP	0.0080	0.0083
TP	0.0167	0.0170
TN	0.2197	0.2283

Station EE2.1

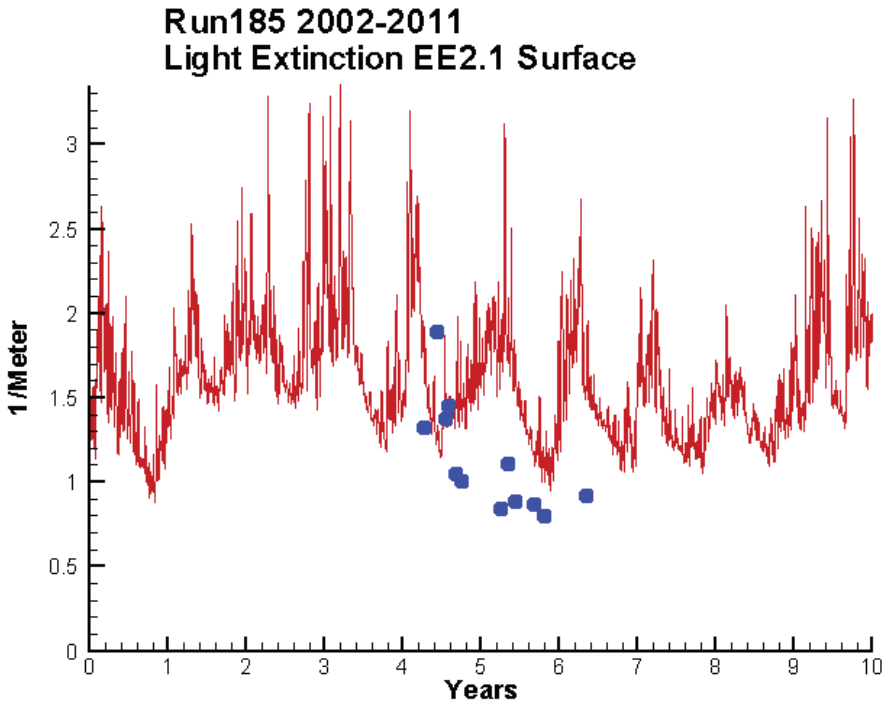


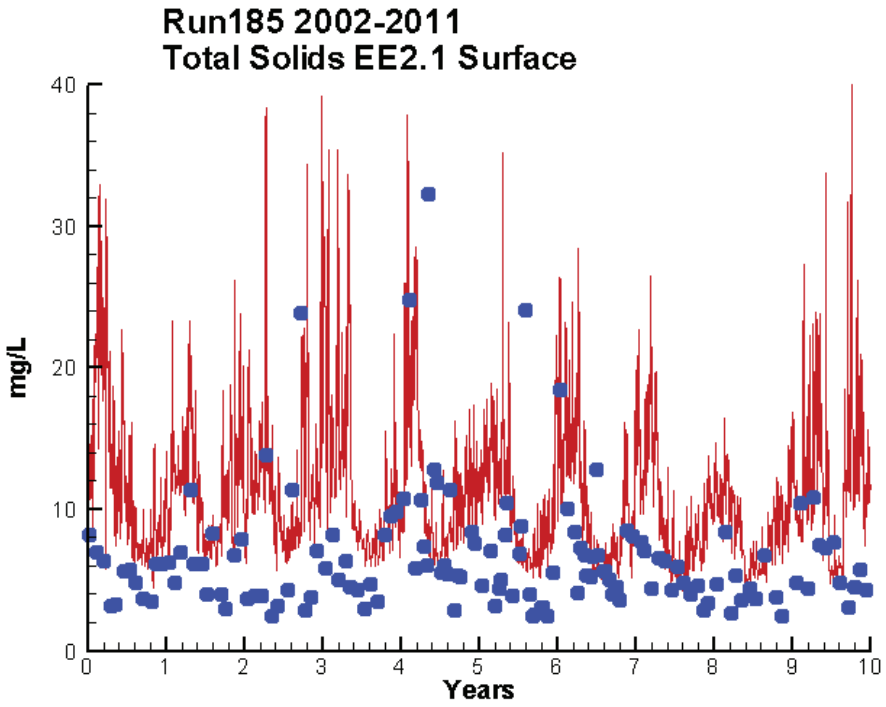


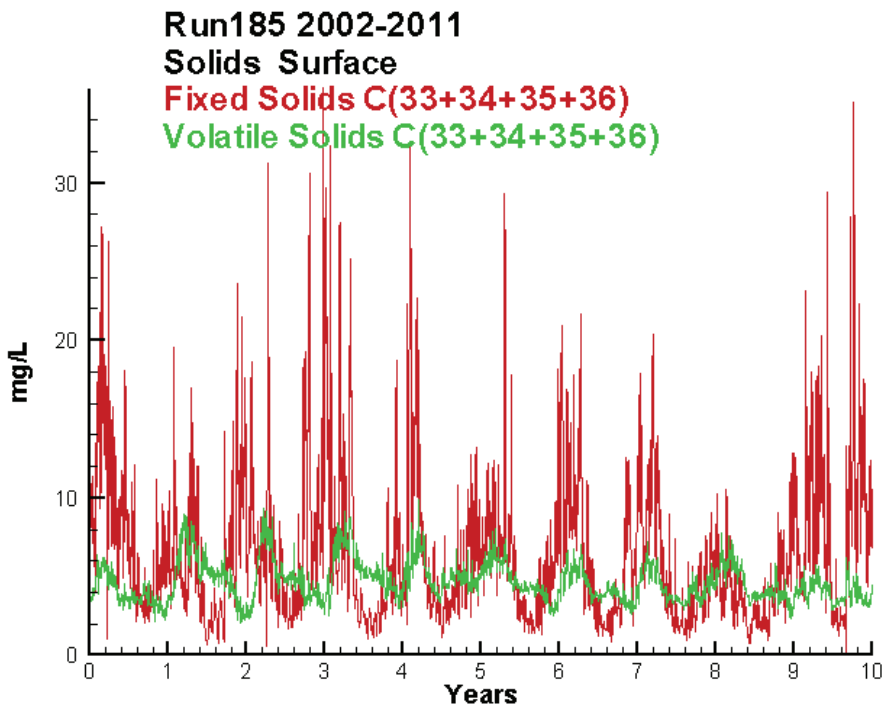


	Mean Difference	Absolute Mean Difference
Top DO	-0.1543	0.7369
Mid DO	-0.1037	0.6982
Bot DO	0.0468	0.8543

Station EE2.1

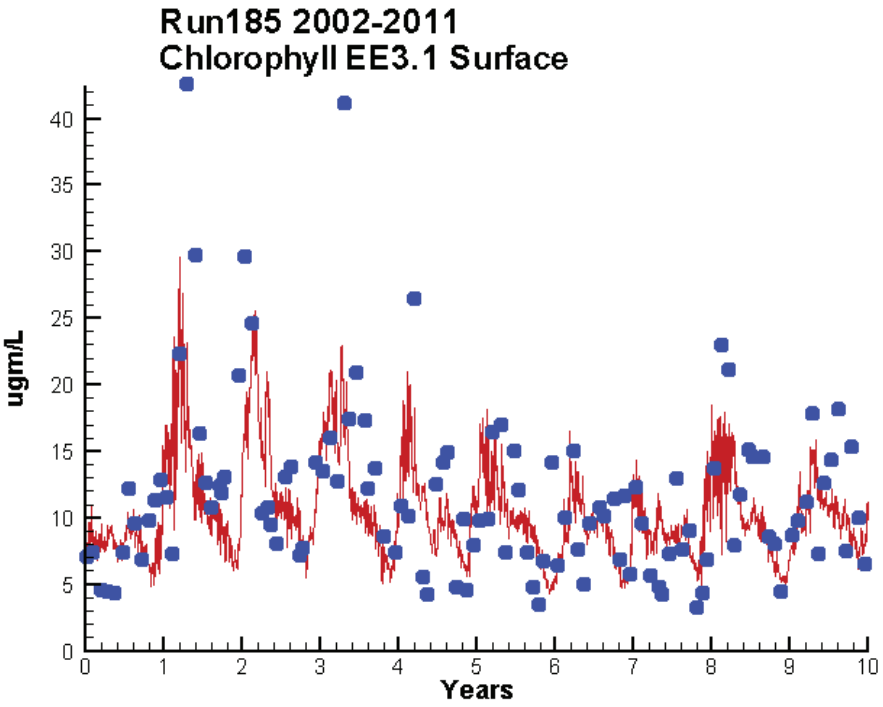


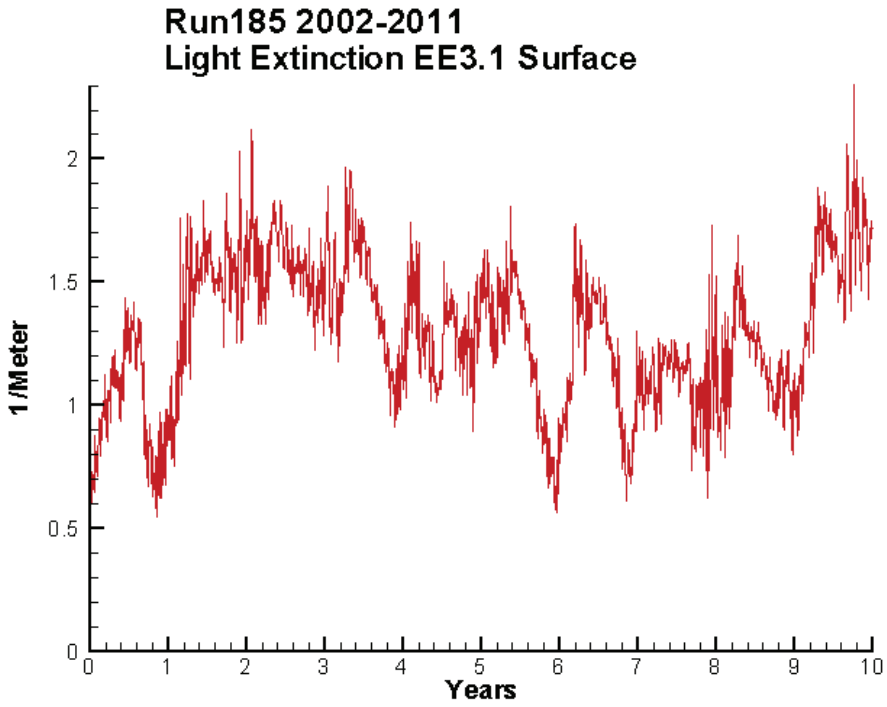


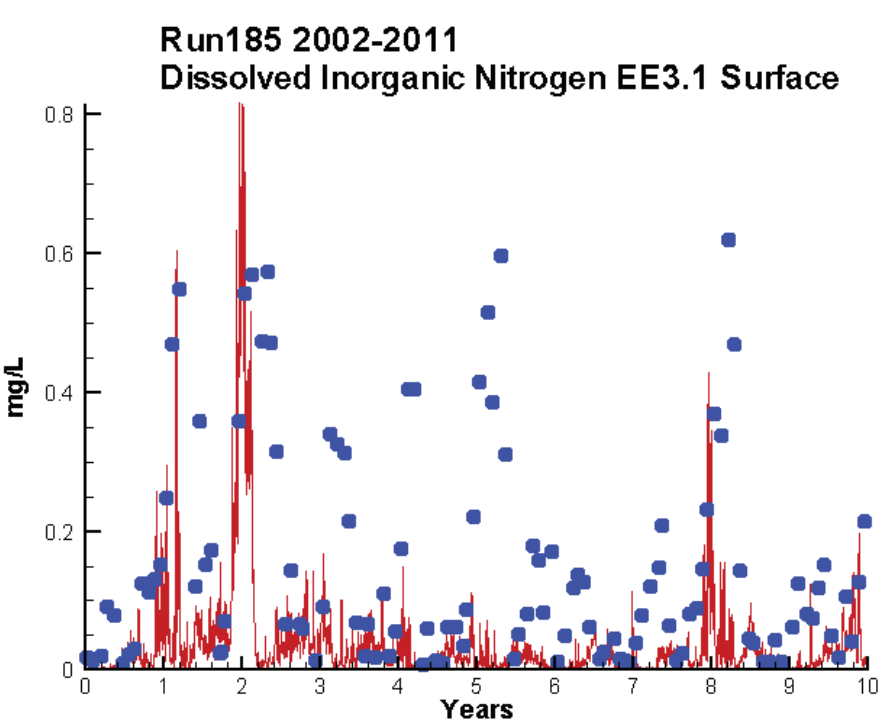


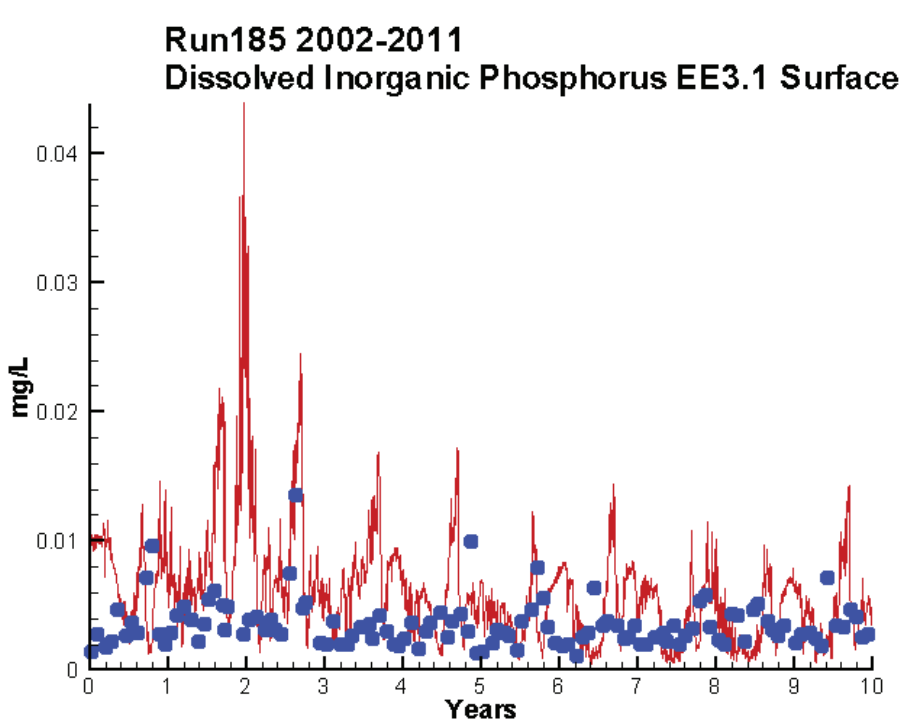
	Mean Difference	Absolute Mean Difference
KE	0.3670	0.4848
TSS	3.9311	5.3306

Station EE3.1

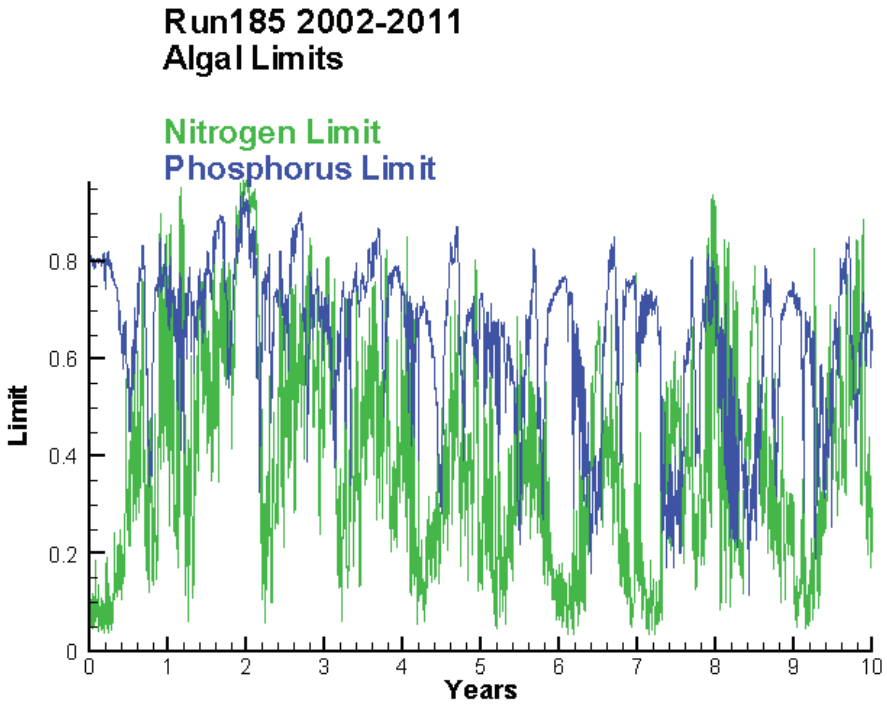


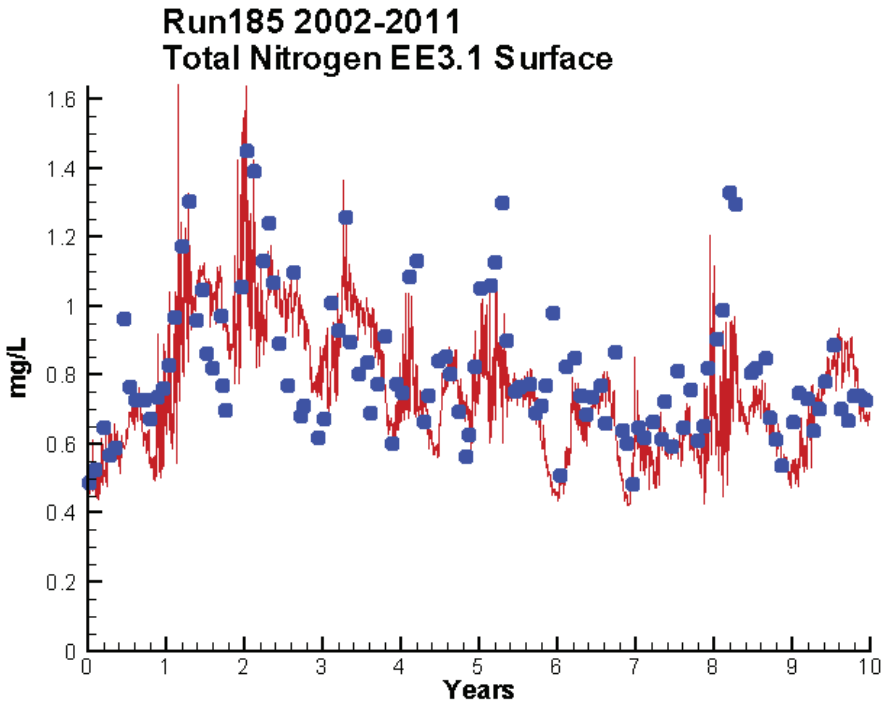


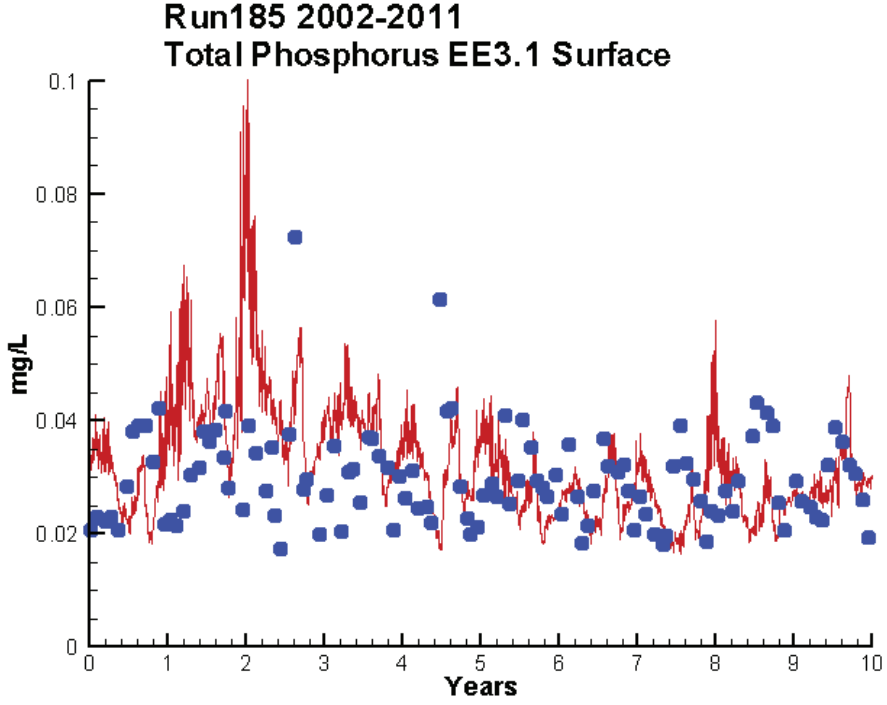




Station EE3.1

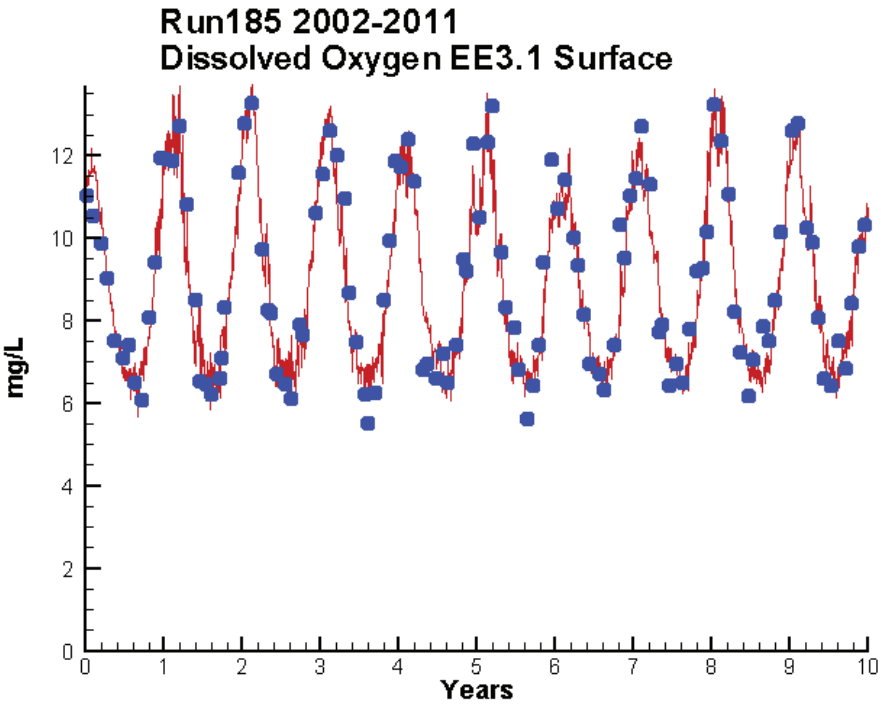


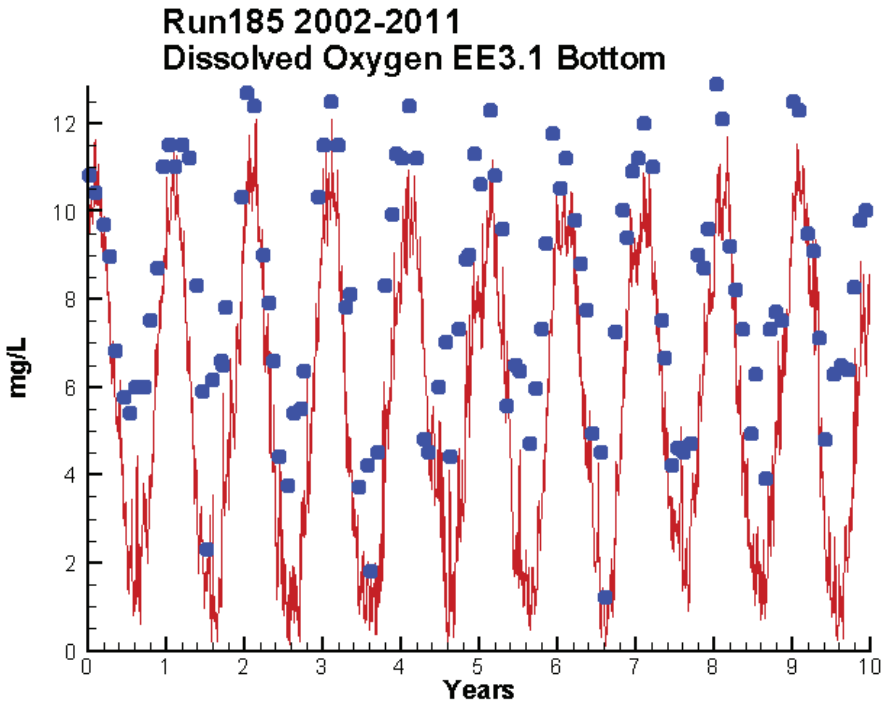


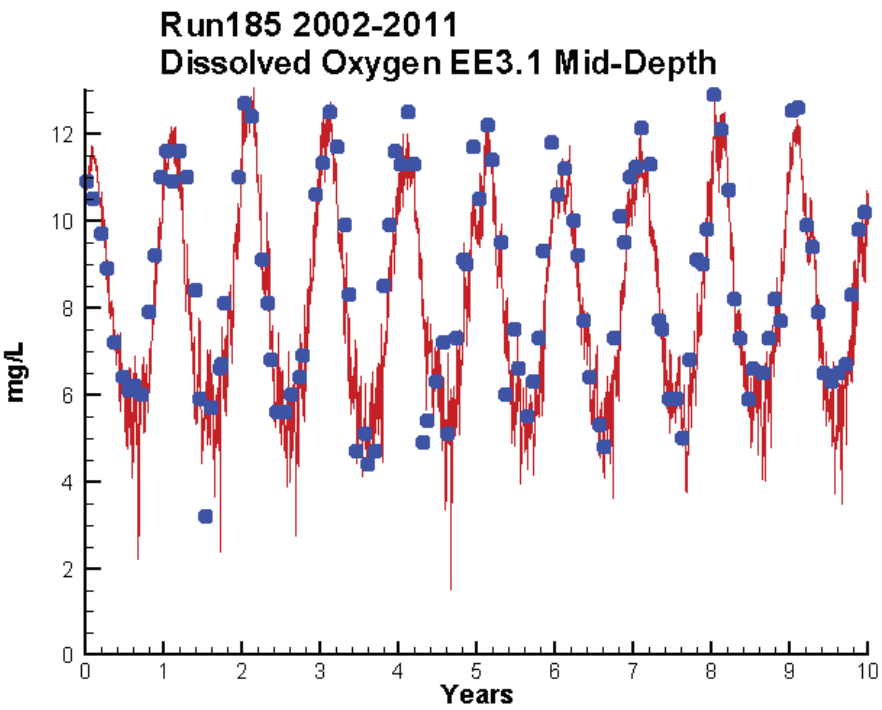


	Mean Difference	Absolute Mean Difference
Chl	-1.1486	4.2877
DIN	-0.1139	0.1272
KE	-0.1139	0.1272
DIP	0.0025	0.0037
TP	0.0028	0.0097
TN	-0.0537	0.1349

Station EE3.1

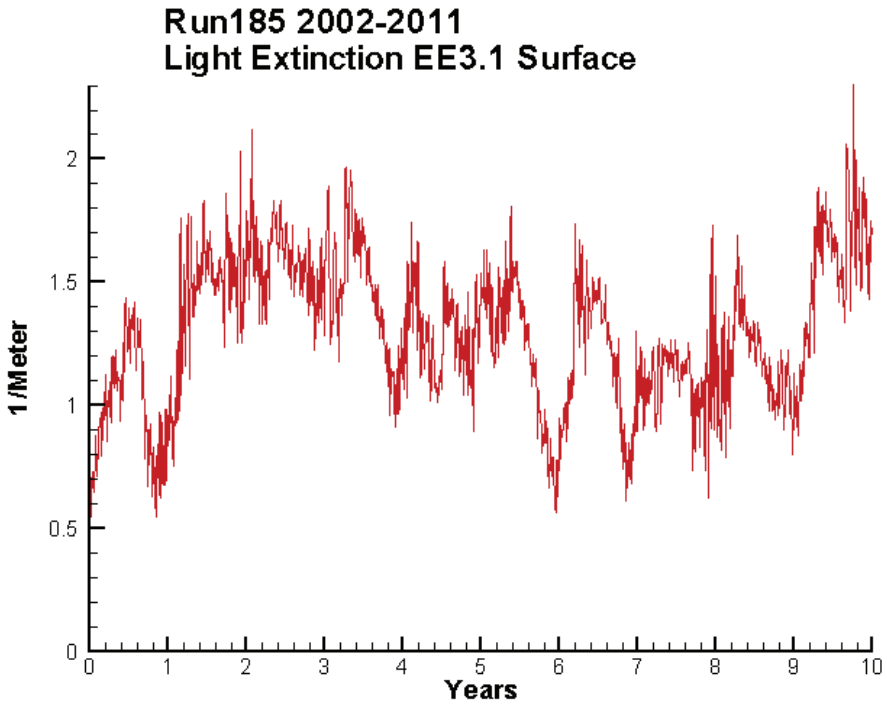


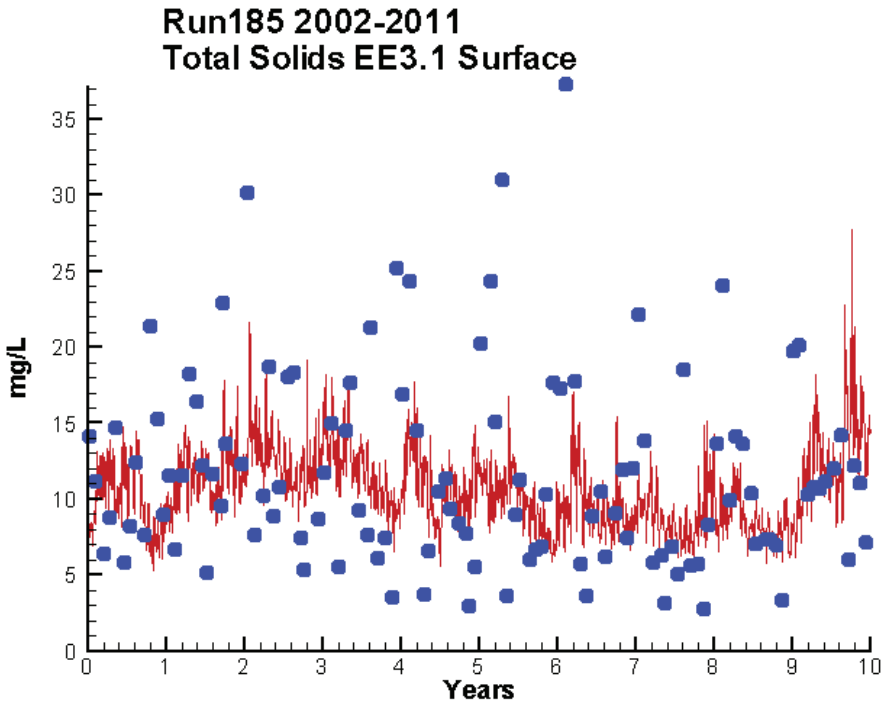


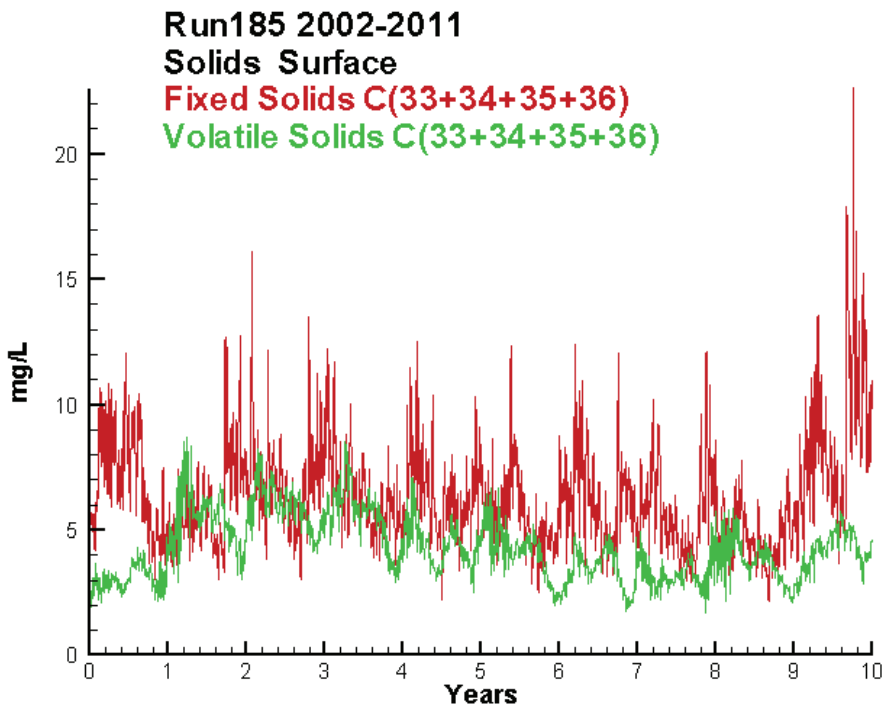


	Mean Difference	Absolute Mean Difference
Top DO	-0.0531	0.5547
Mid DO	-0.4940	0.8236
Bot DO	-2.5822	2.6253

Station EE3.1

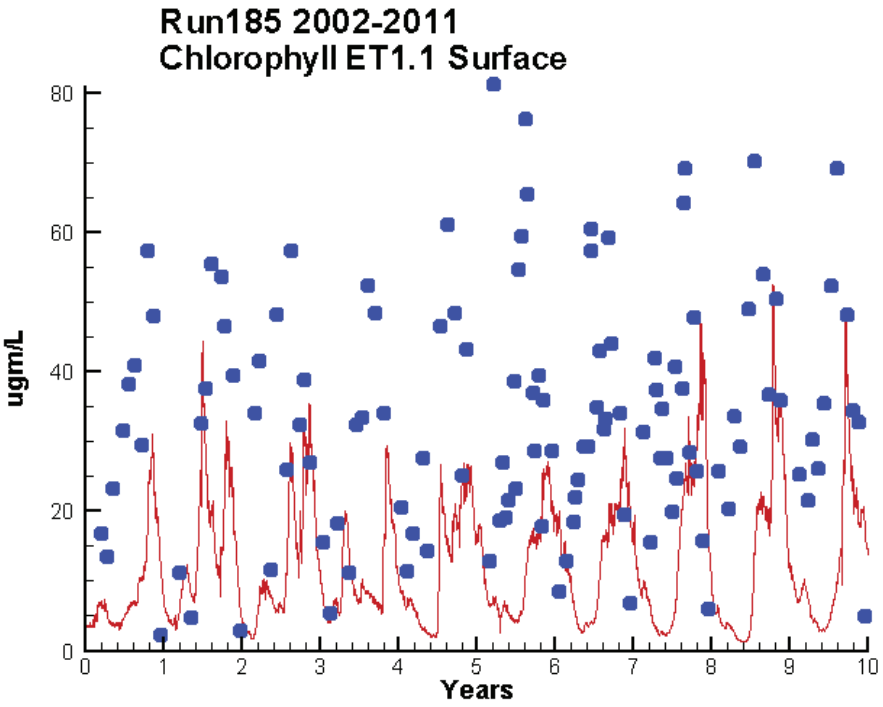


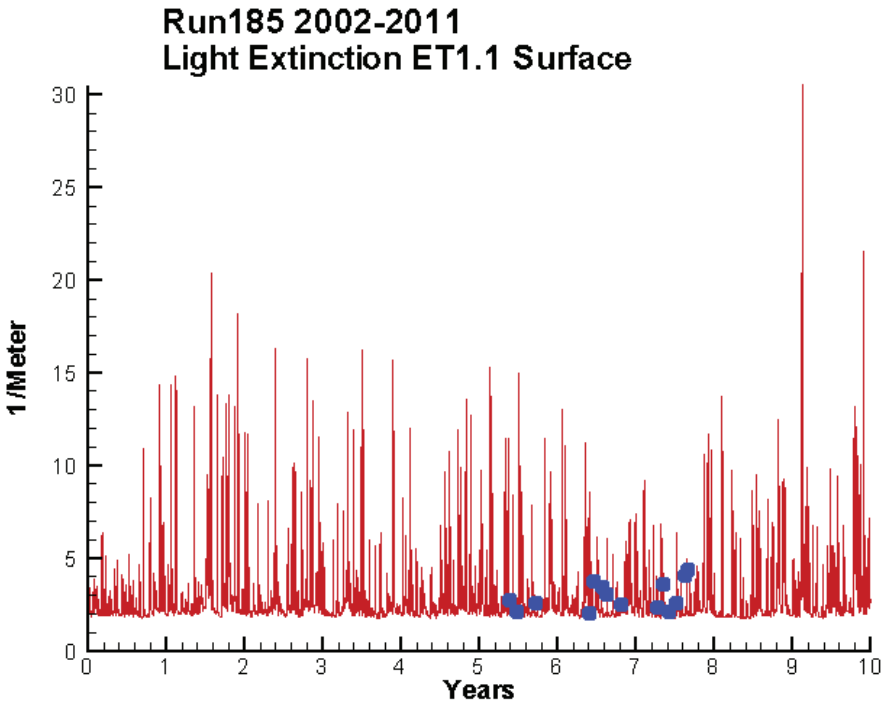


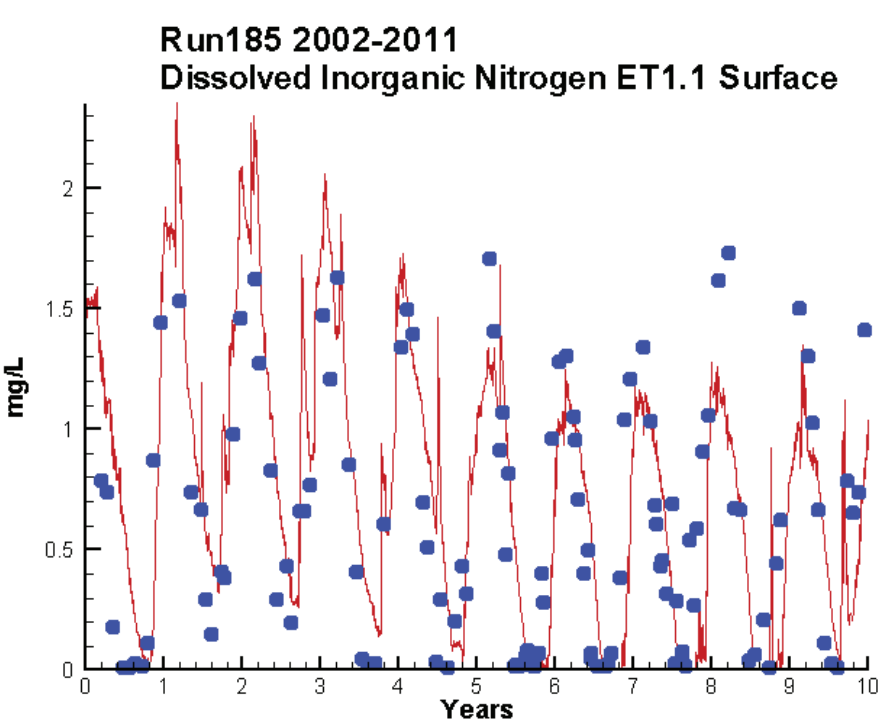


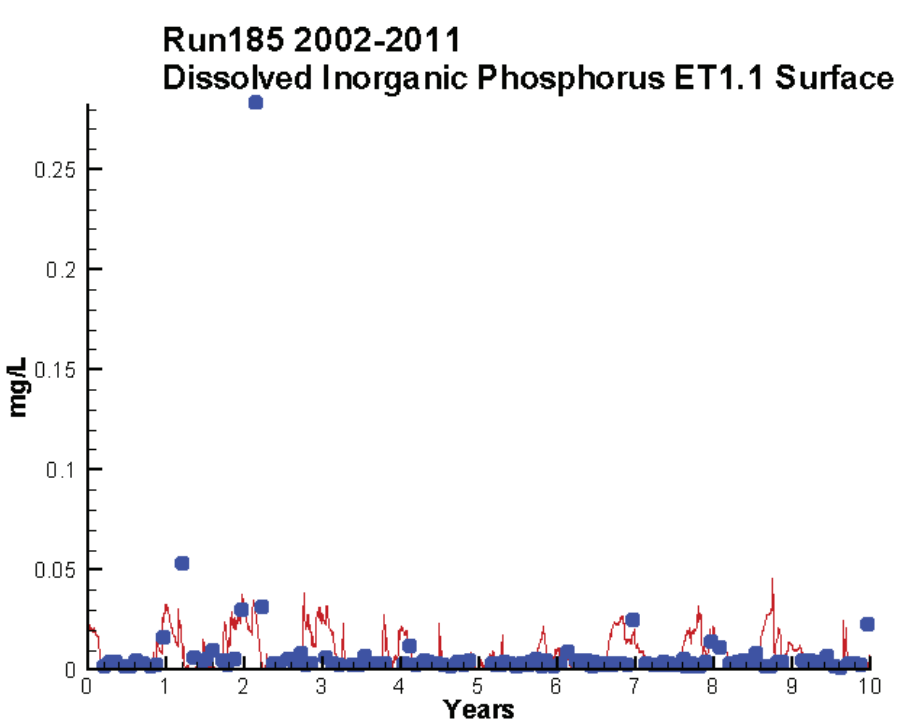
	Mean Difference	Absolute Mean Difference
KE	-0.0537	0.1349
TSS	-1.1454	4.7198

Station ET1.1



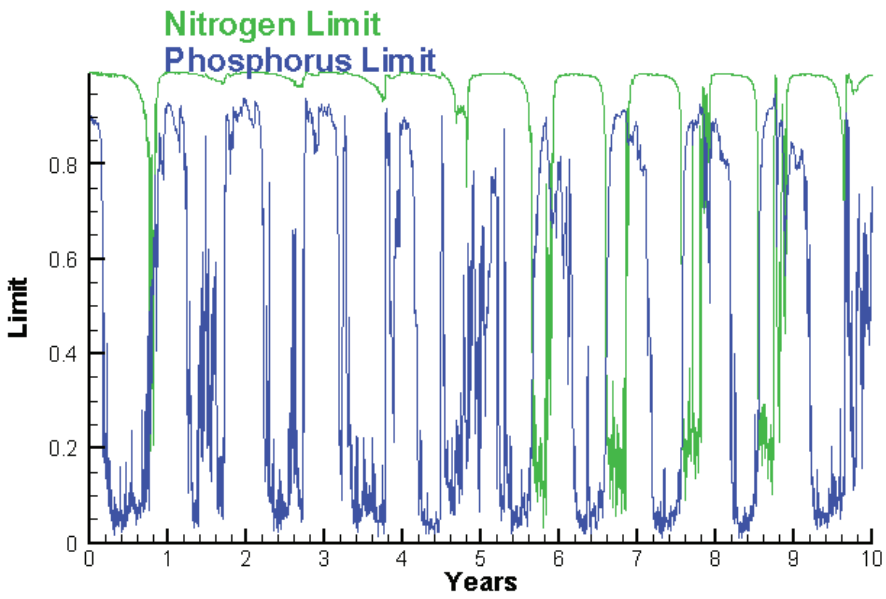




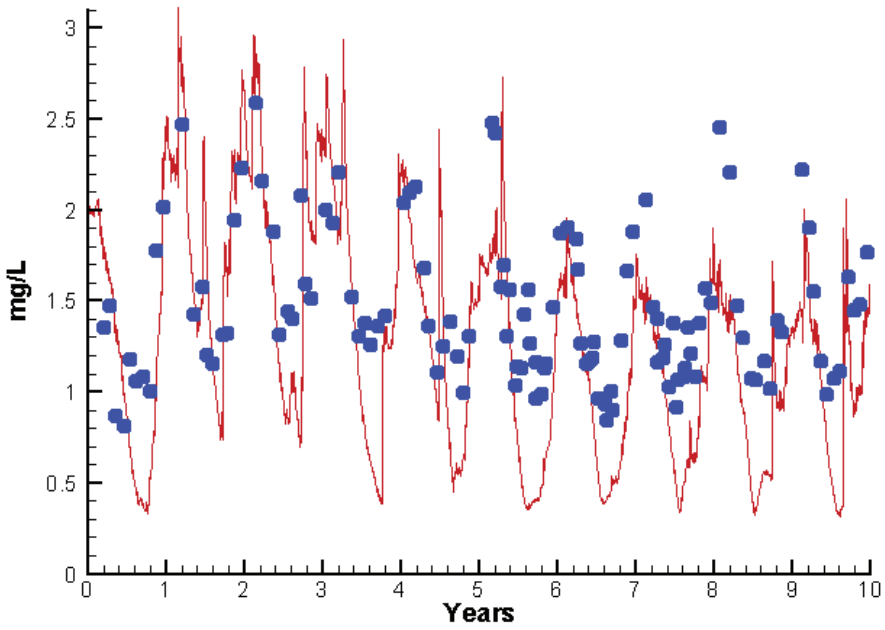


Station ET1.1

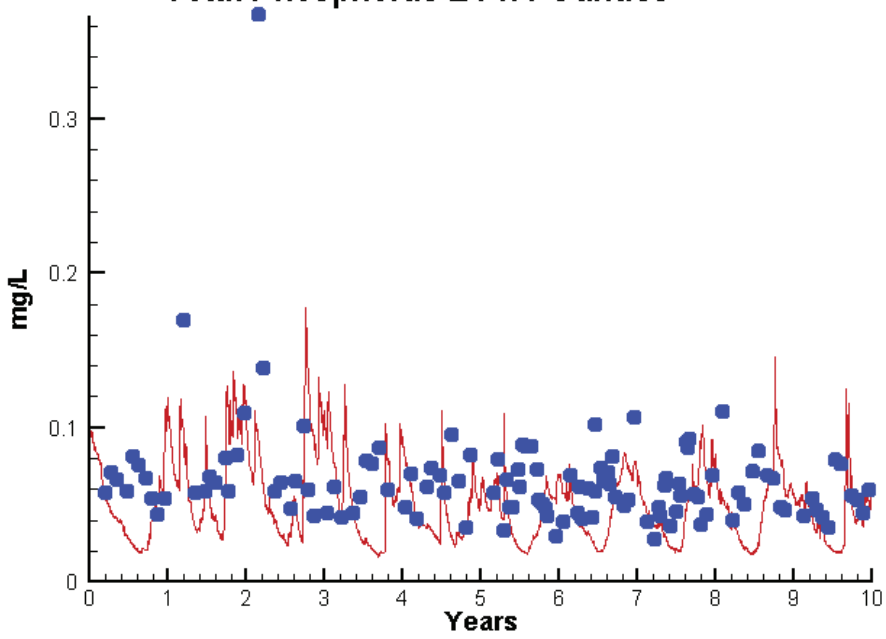
Run185 2002-2011
Algal Limits



Run185 2002-2011
Total Nitrogen ET1.1 Surface

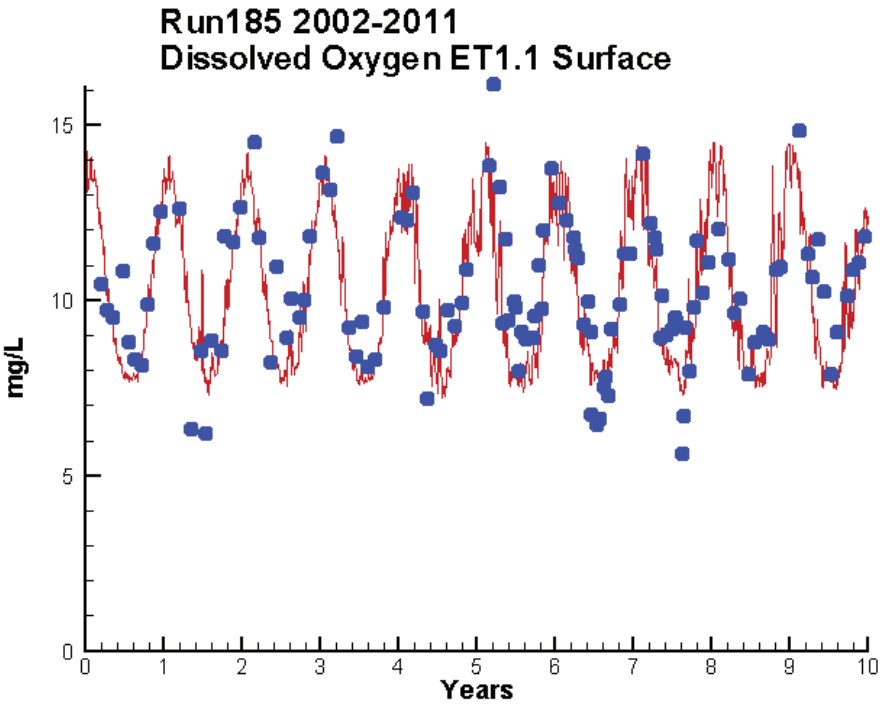


Run185 2002-2011
Total Phosphorus ET1.1 Surface



	Mean Difference	Absolute Mean Difference
Chl	-20.6924	22.6306
DIN	0.0533	0.2898
KE	-0.5979	0.7760
DIP	-0.0009	0.0084
TP	-0.0176	0.0301
TN	-0.3030	0.4243

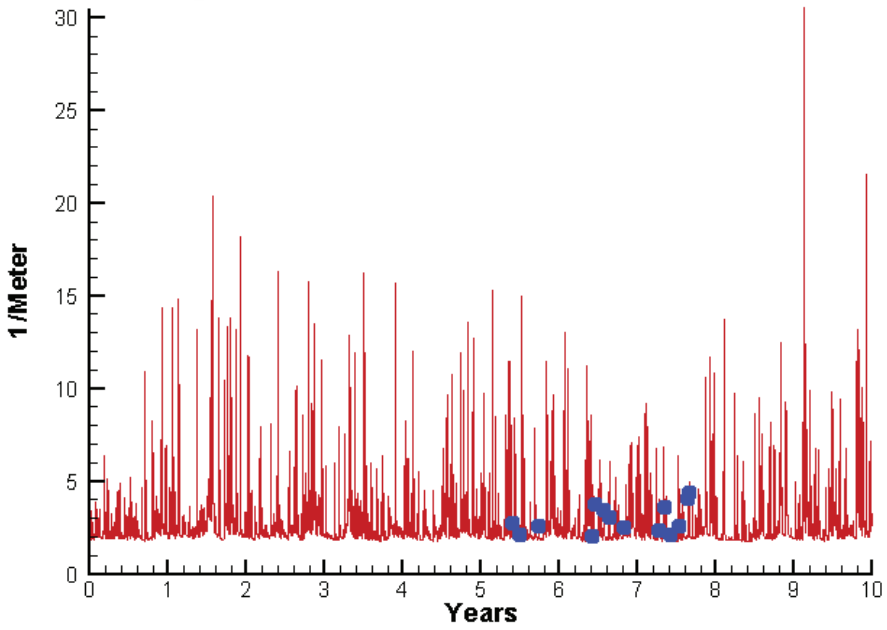
Station ET1.1



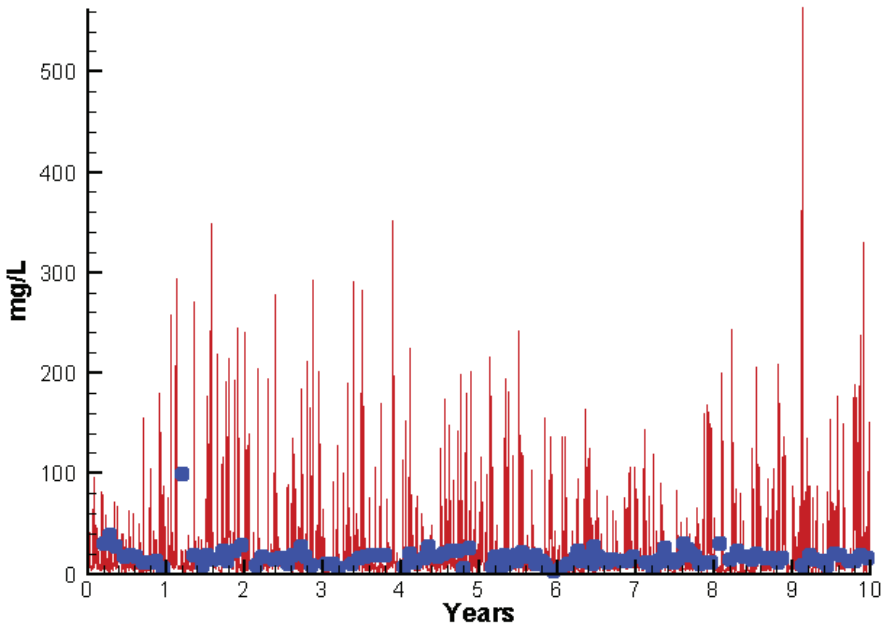
	Mean Difference	Absolute Mean Difference
Top DO	-0.4410	1.0019

Station ET1.1

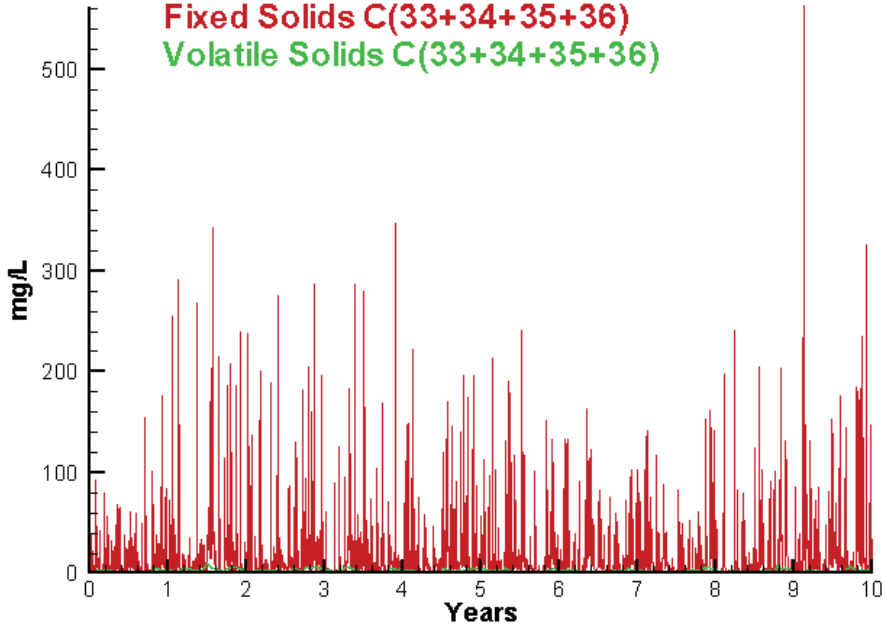
Run185 2002-2011
Light Extinction ET1.1 Surface



Run185 2002-2011
Total Solids ET1.1 Surface

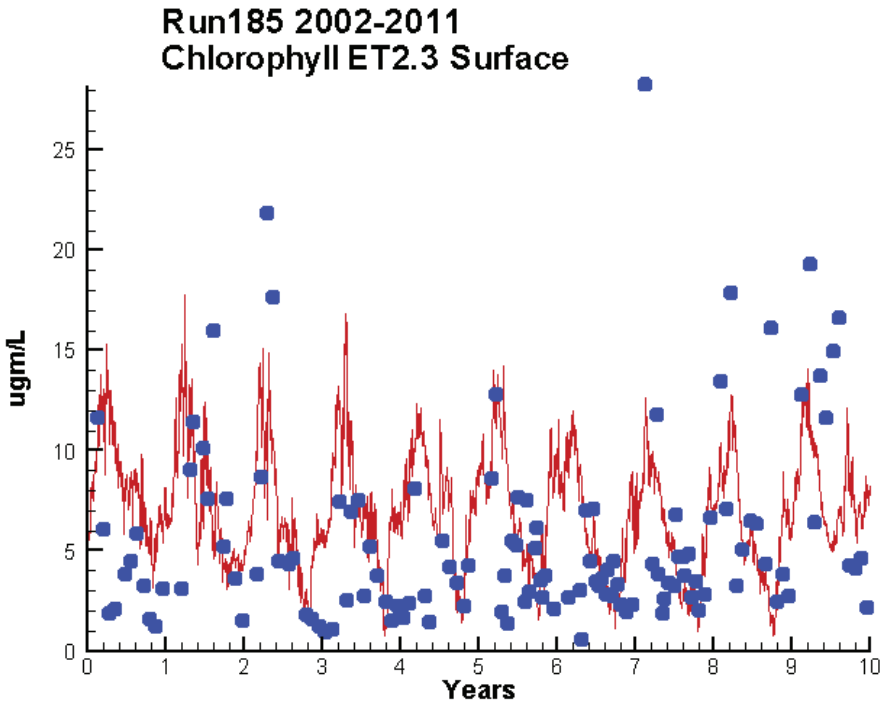


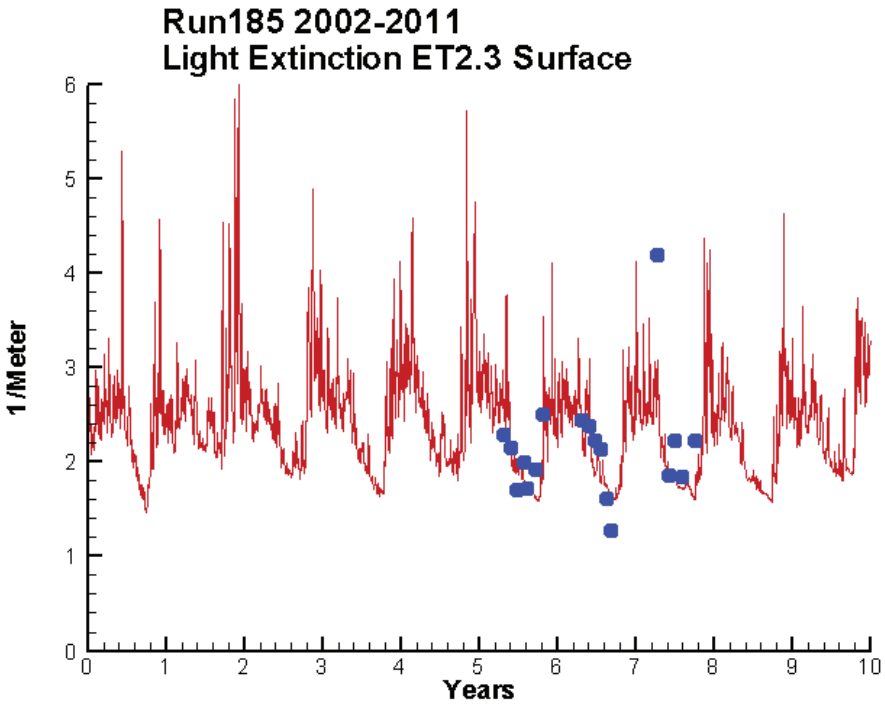
Run185 2002-2011
Solids Surface
Fixed Solids C(33+34+35+36)
Volatile Solids C(33+34+35+36)

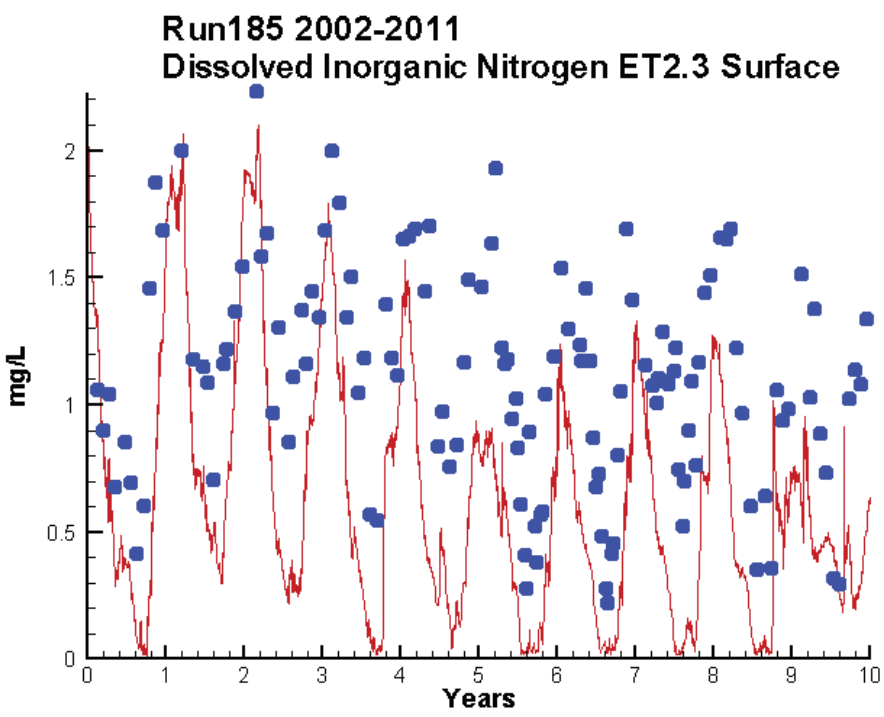


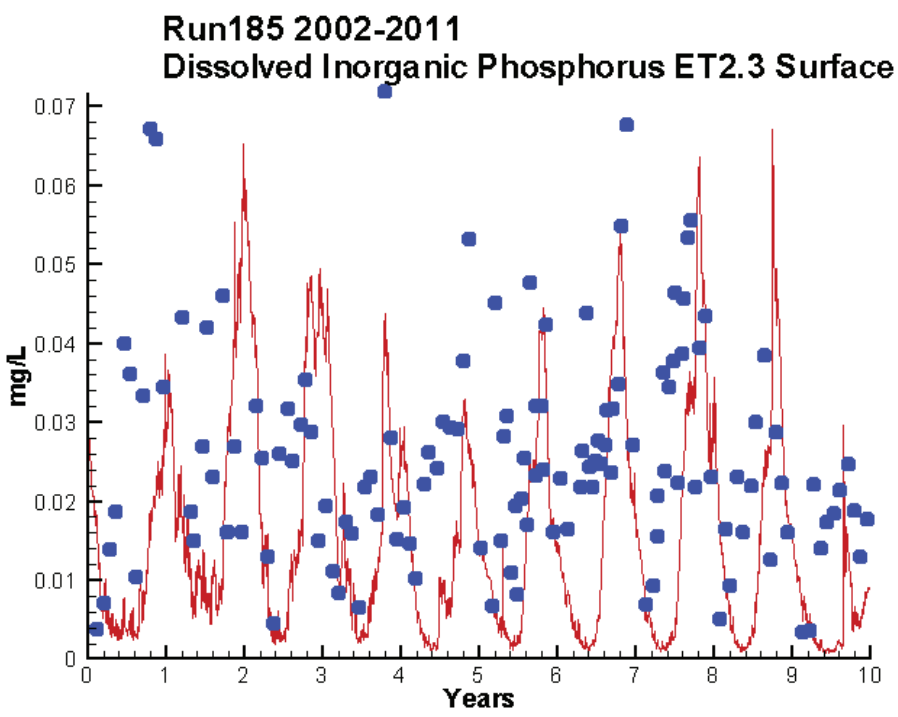
	Mean Difference	Absolute Mean Difference
KE	-0.5979	0.7760
TSS	0.4981	14.3498

Station ET2.3

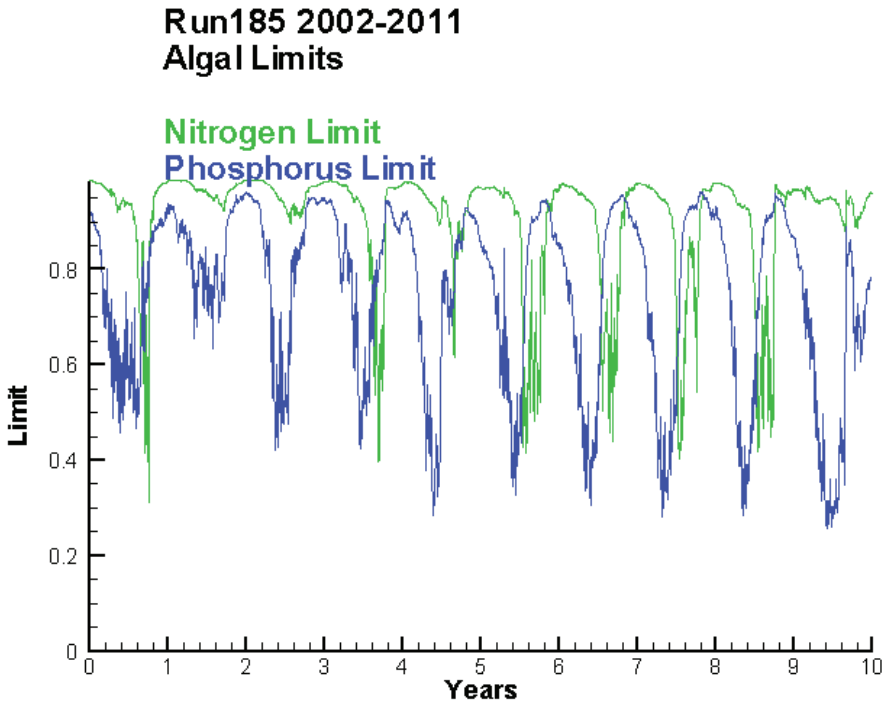


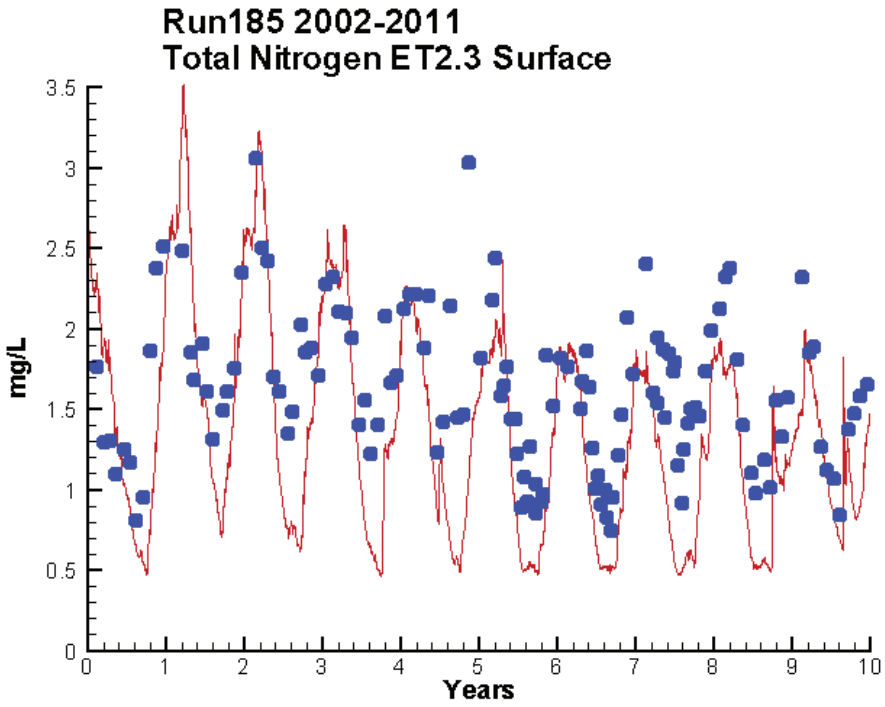


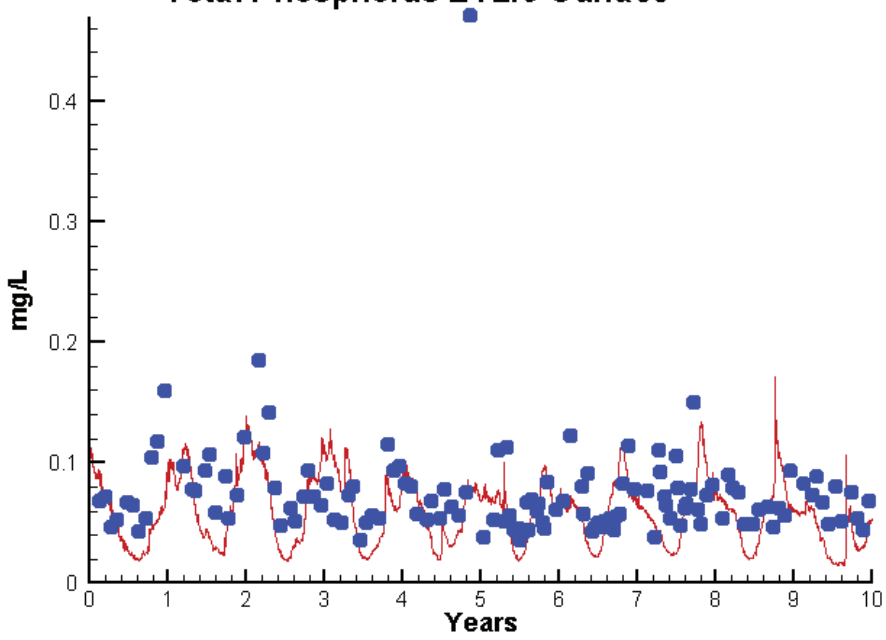




Station ET2.3

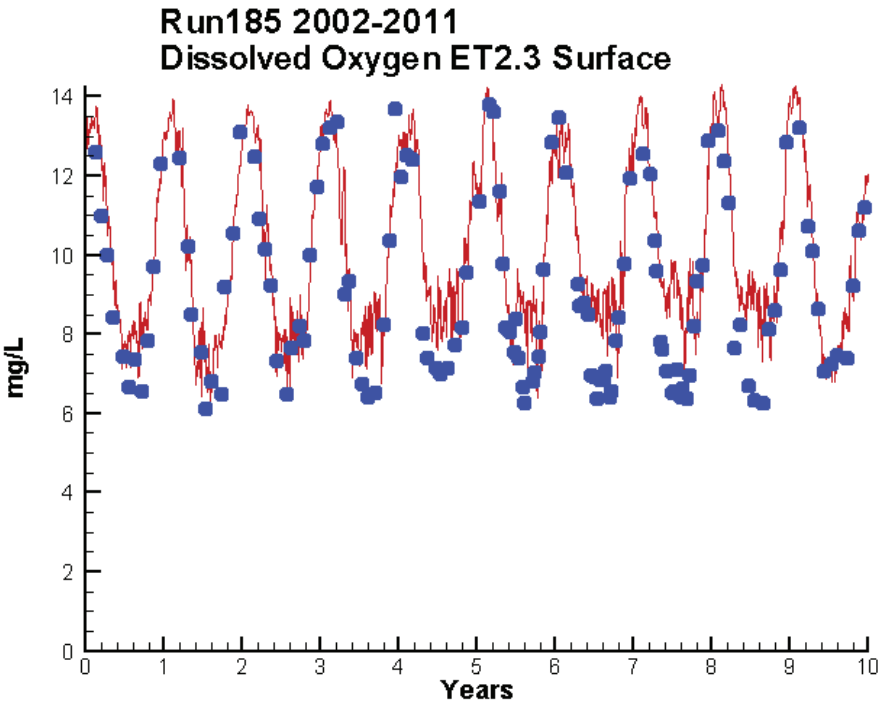






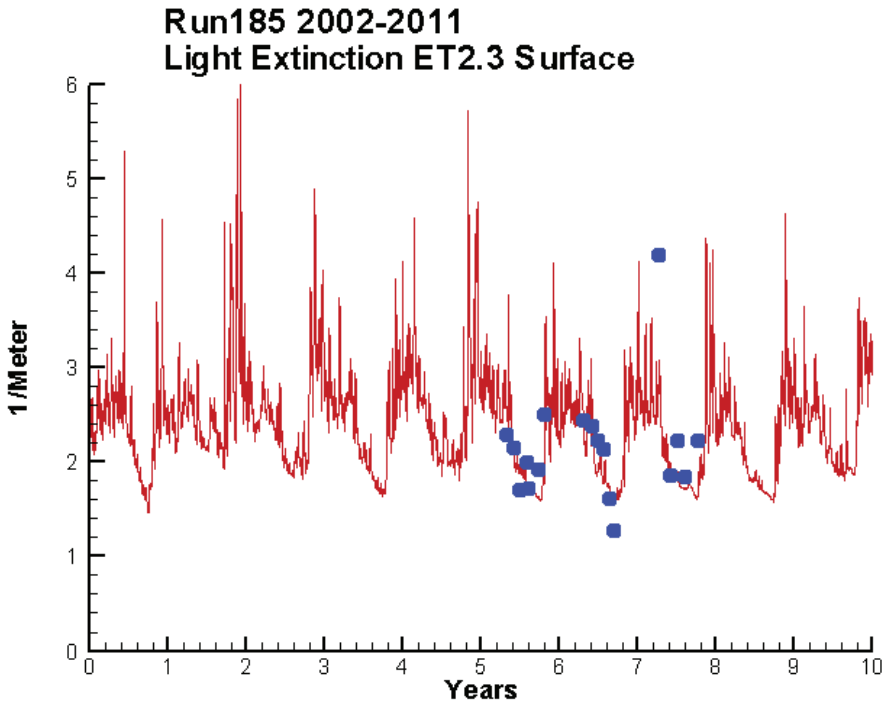
	Mean Difference	Absolute Mean Difference
Chl	1.1123	3.6530
DIN	-0.5663	0.5770
KE	-0.0950	0.3220
DIP	-0.0099	0.0155
TP	-0.0162	0.0300
TN	-0.3727	0.4712

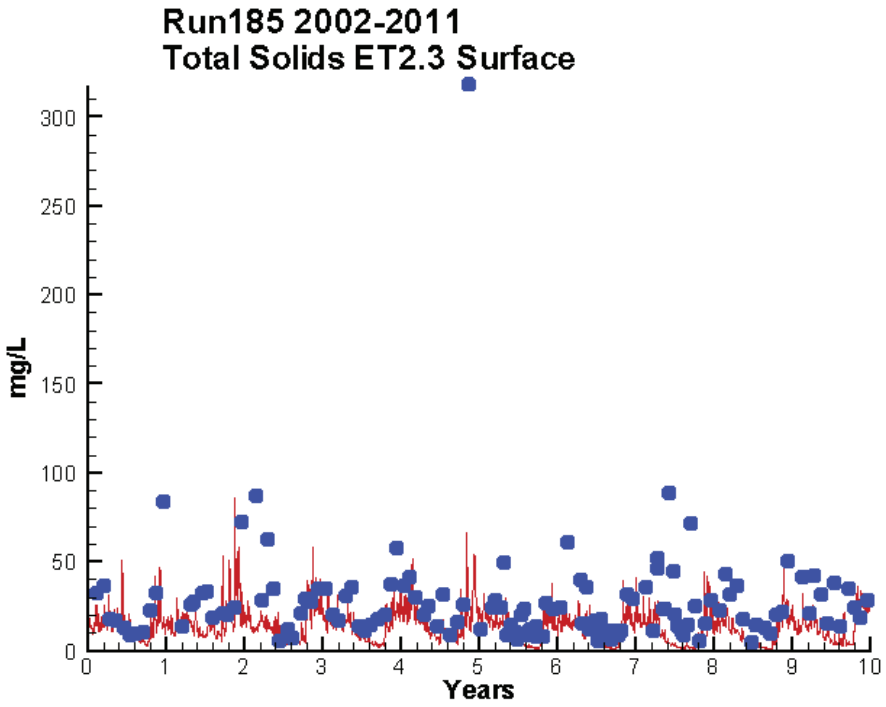
Station ET2.3

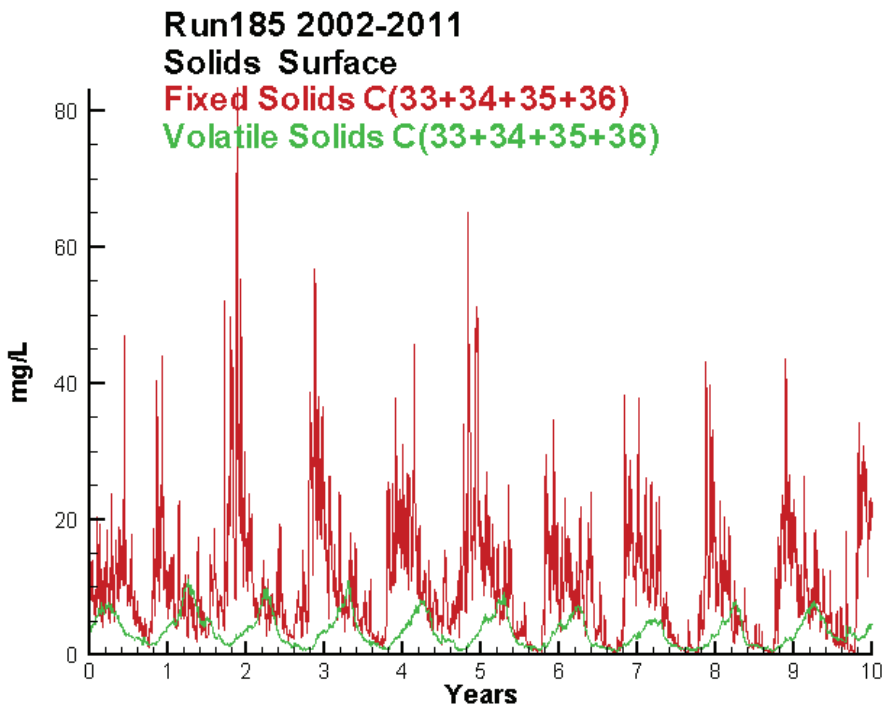


	Mean Difference	Absolute Mean Difference
Top DO	0.7649	0.9706

Station ET2.3

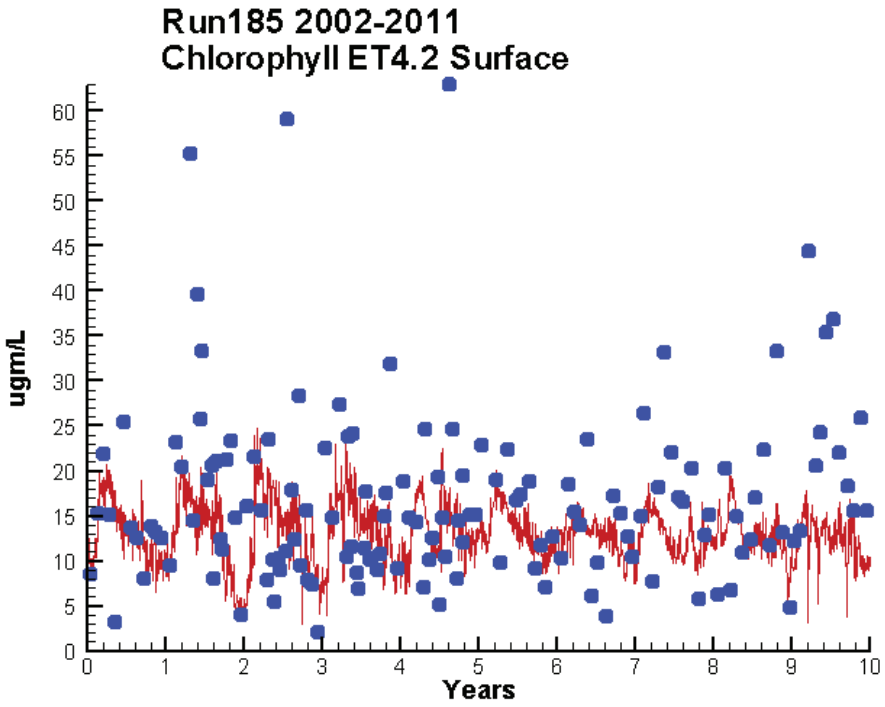


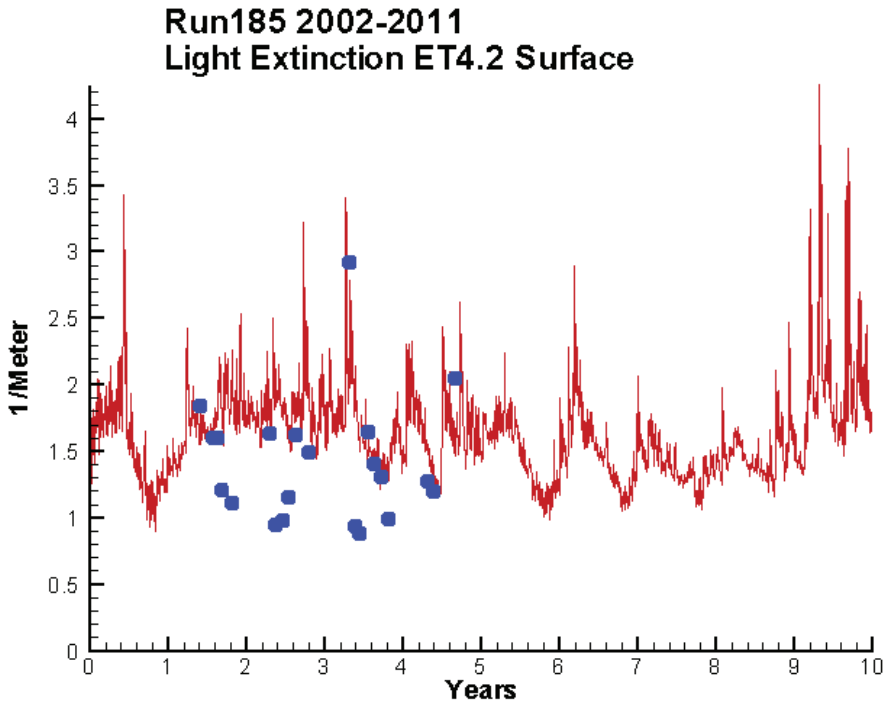


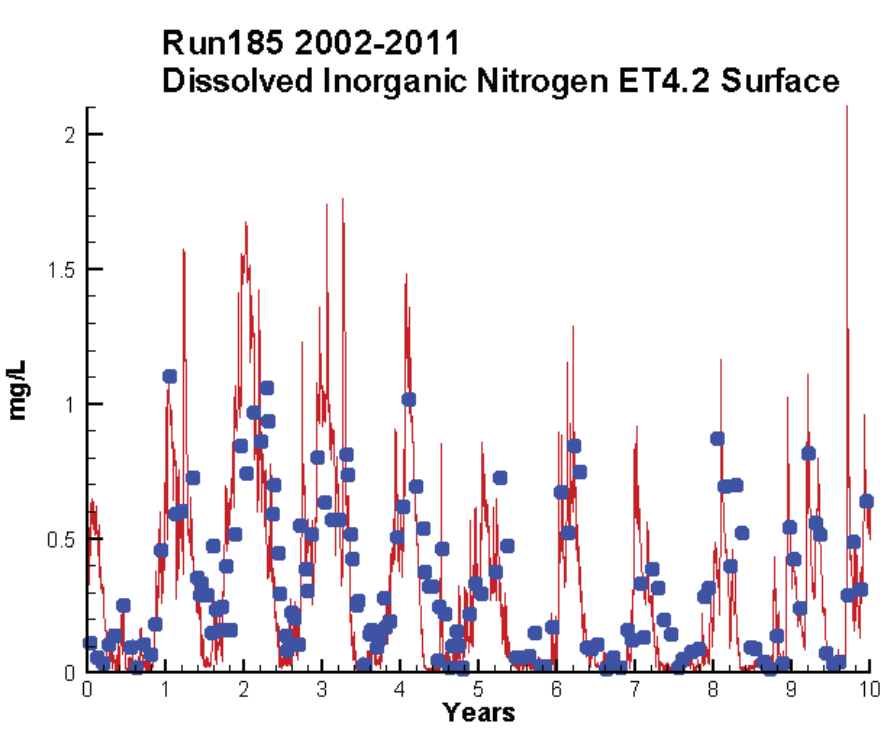


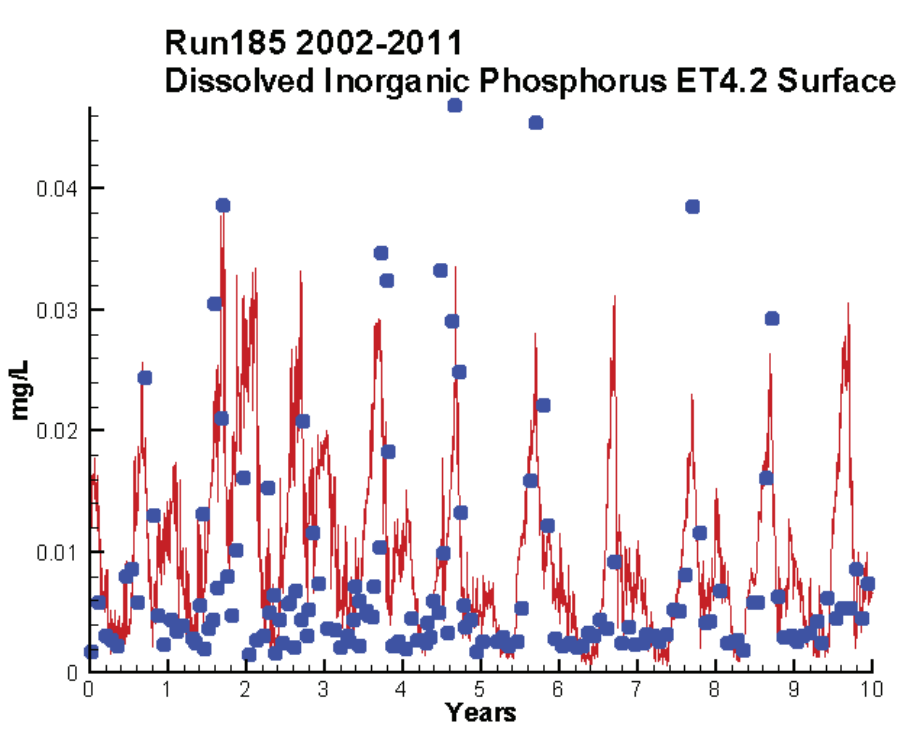
	Mean Difference	Absolute Mean Difference
KE	-0.0950	0.3220
TSS	-14.5140	16.6911

Station ET4.2

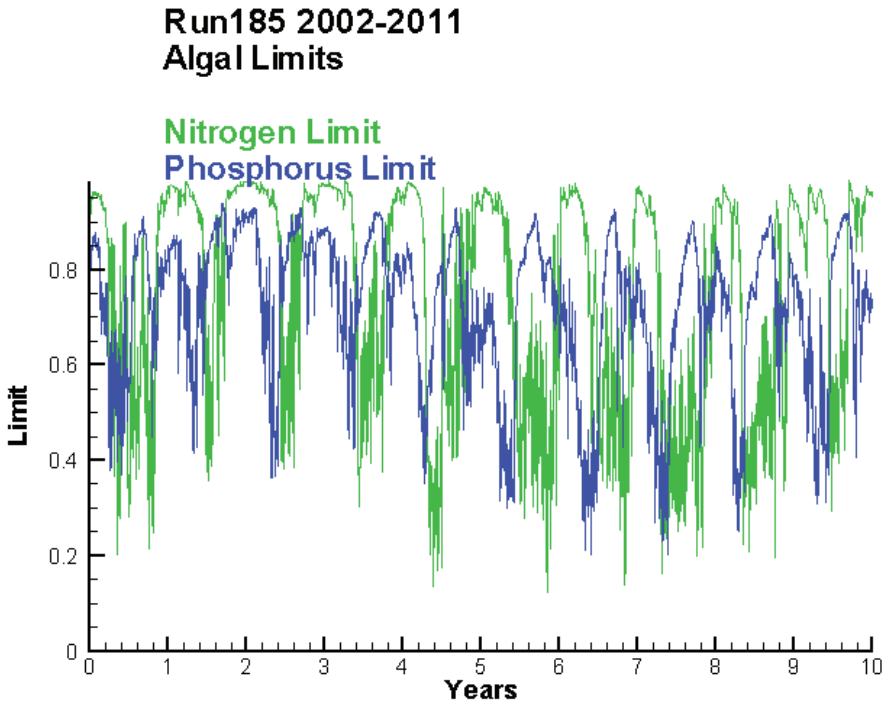


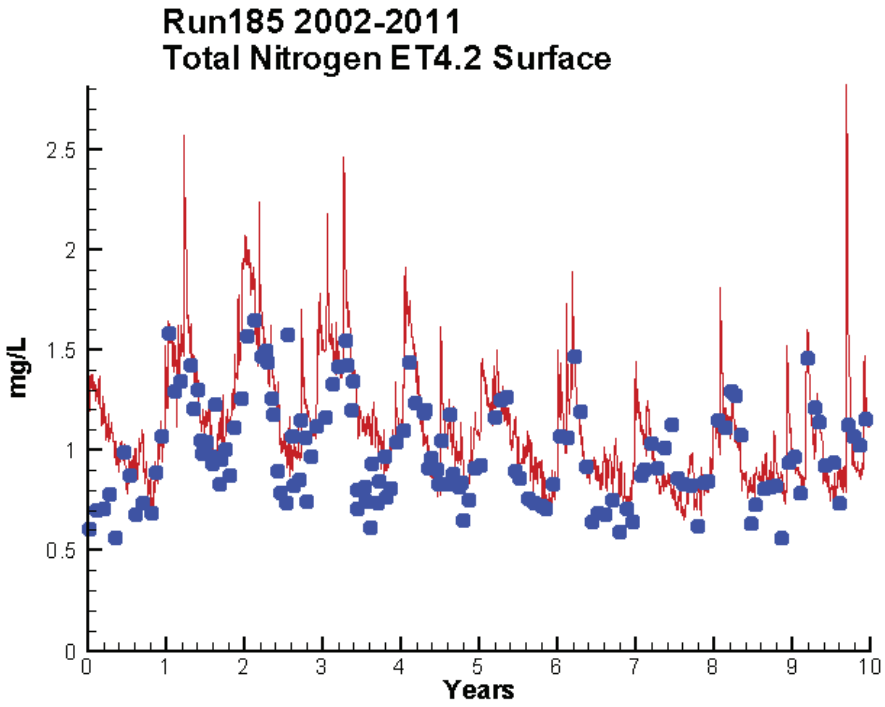


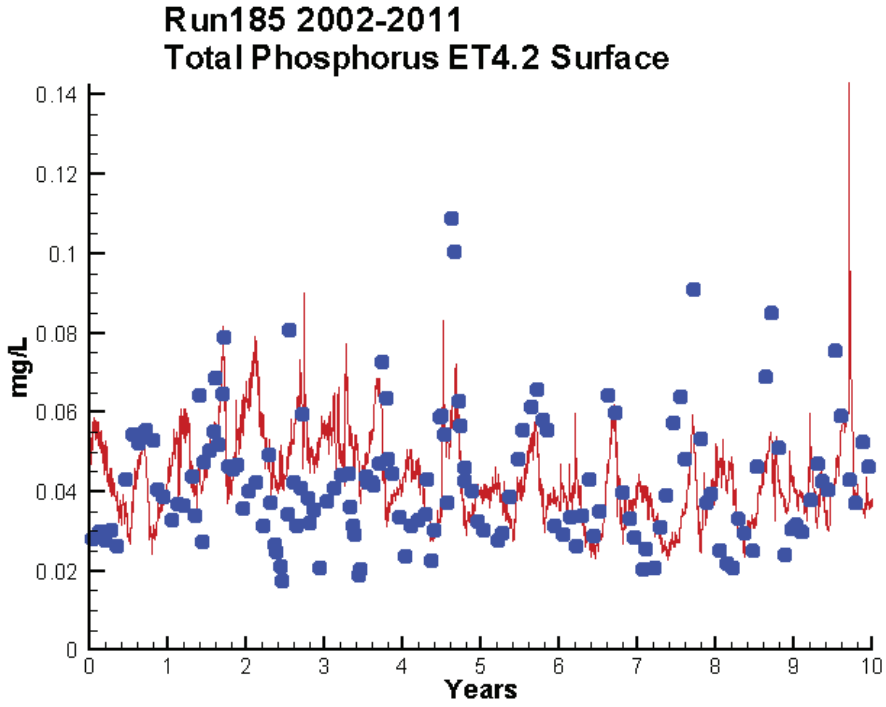




Station ET4.2

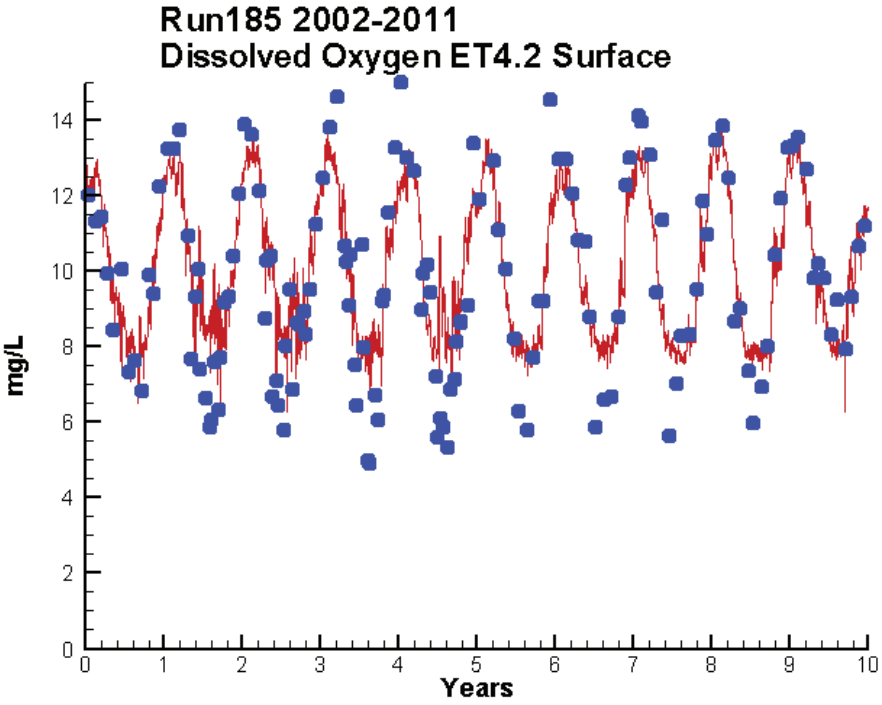






	Mean Difference	Absolute Mean Difference
Chl	-3.3869	7.0386
DIN	-0.0579	0.1689
KE	0.2904	0.4197
DIP	0.0025	0.0067
TP	0.0015	0.0137
TN	0.1166	0.1790

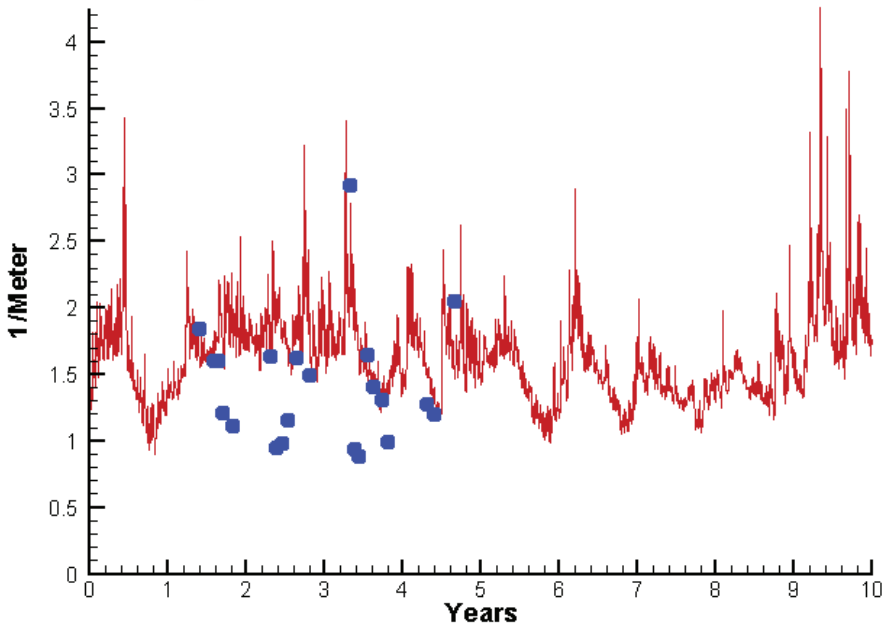
Station ET4.2



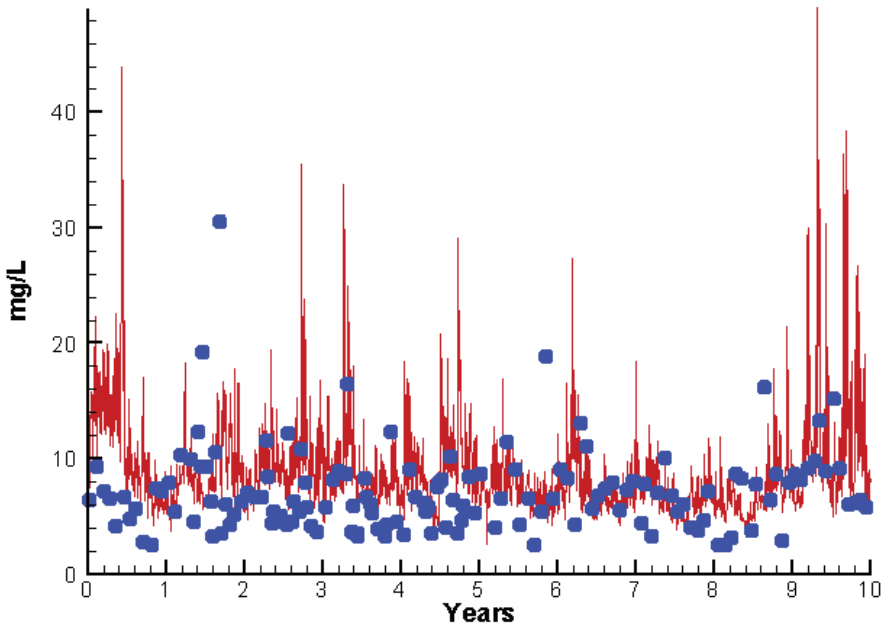
	Mean Difference	Absolute Mean Difference
Top DO	0.2993	1.0471

Station ET4.2

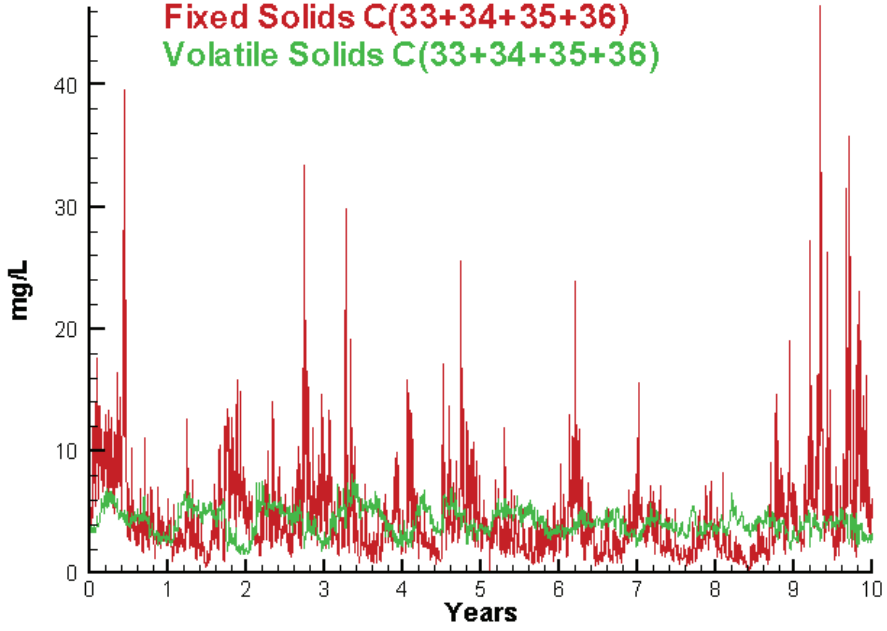
Run185 2002-2011
Light Extinction ET4.2 Surface



Run185 2002-2011
Total Solids ET4.2 Surface

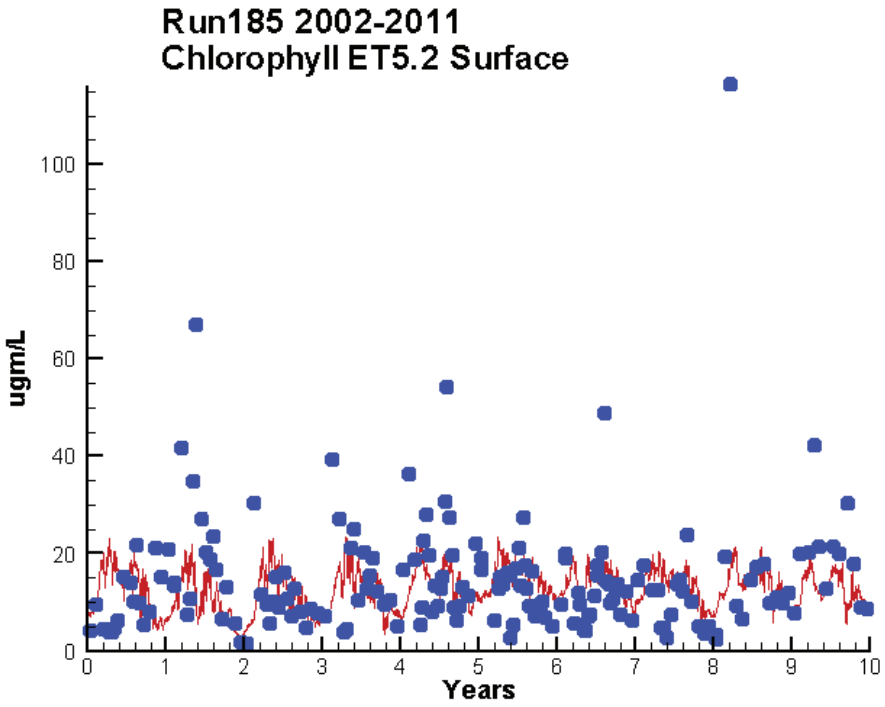


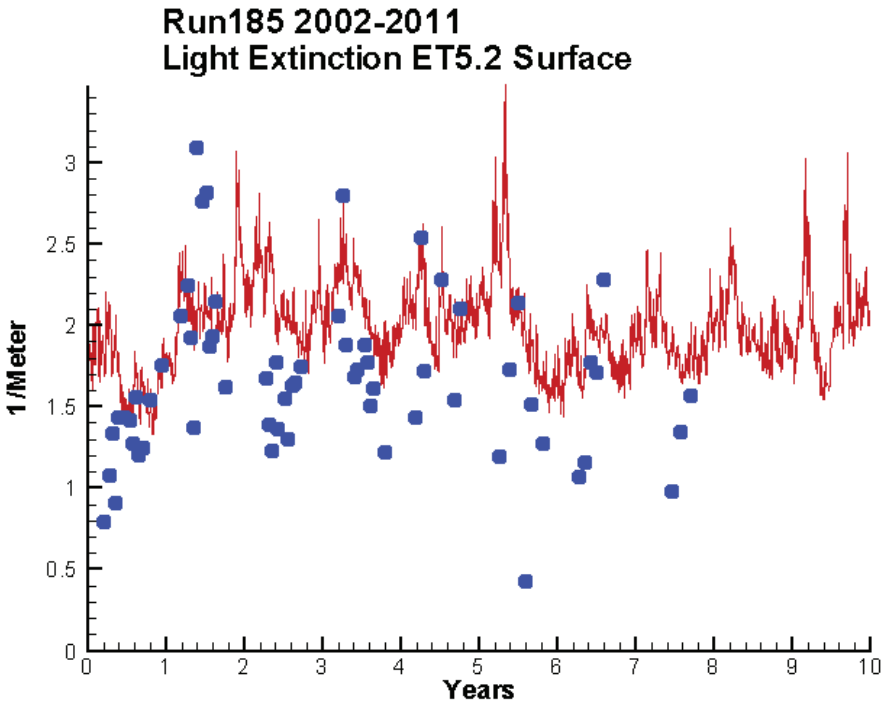
Run185 2002-2011
Solids Surface
Fixed Solids C(33+34+35+36)
Volatile Solids C(33+34+35+36)

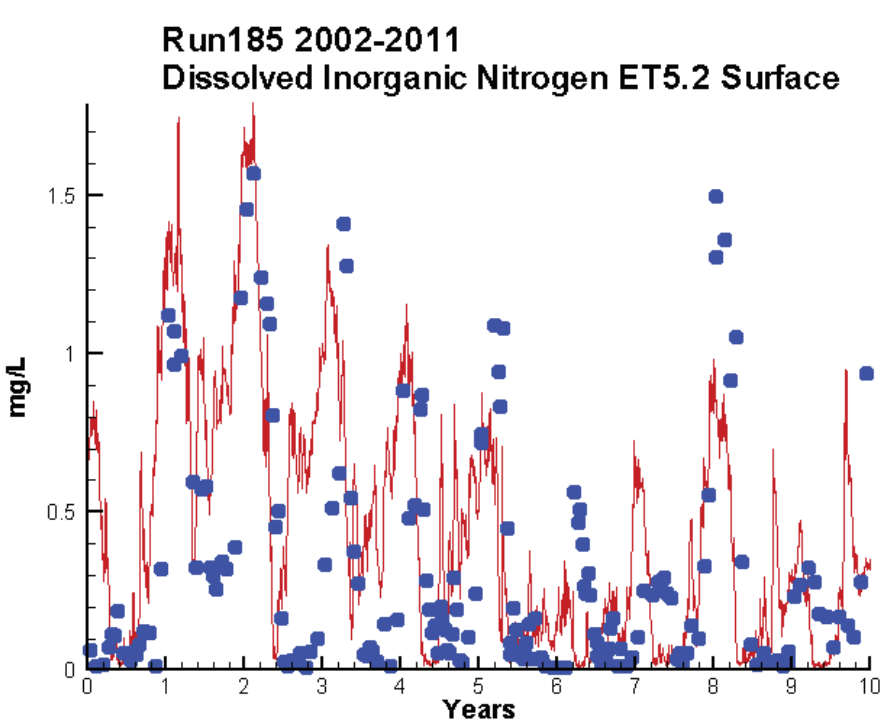


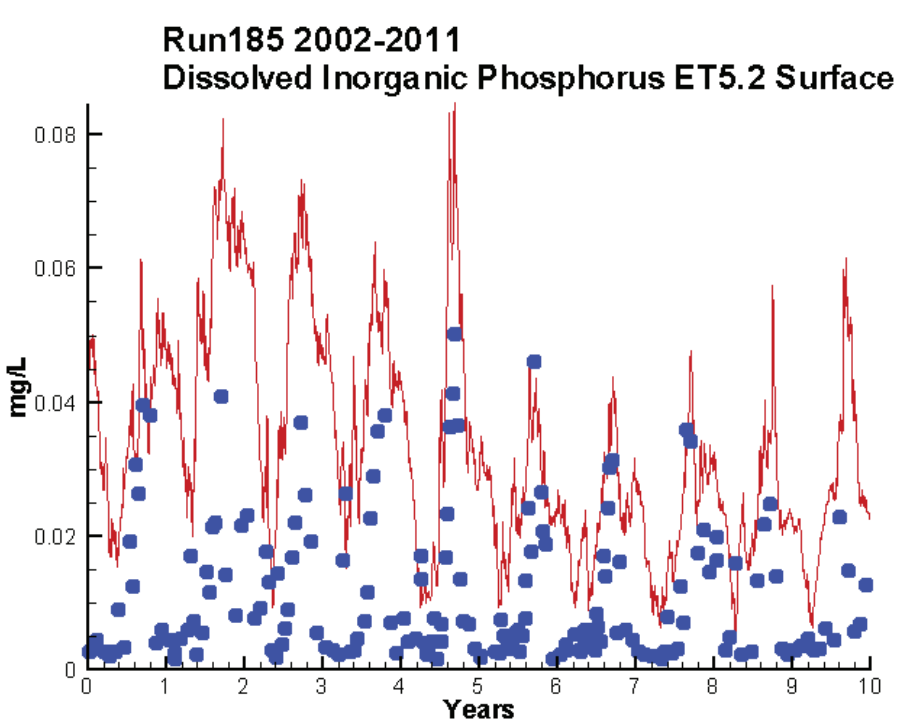
	Mean Difference	Absolute Mean Difference
KE	0.2904	0.4197
TSS	1.6896	3.6034

Station ET5.2

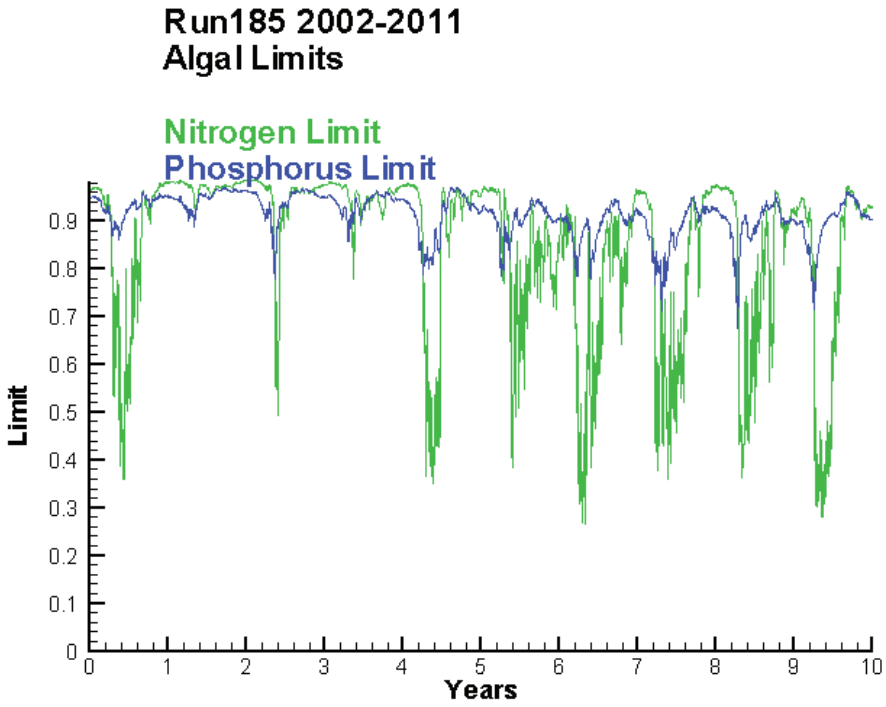


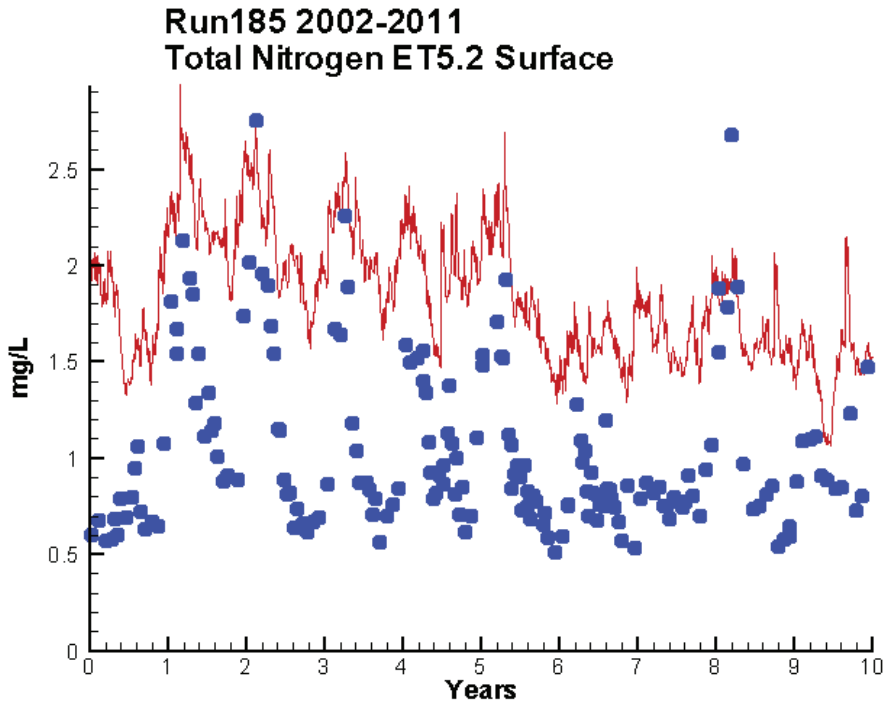


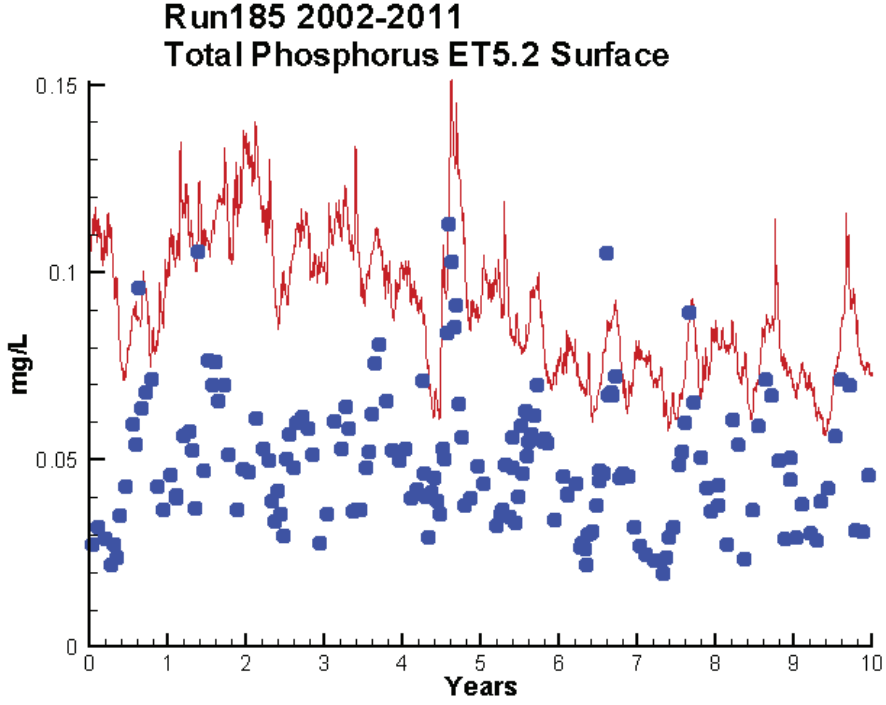




Station ET5.2

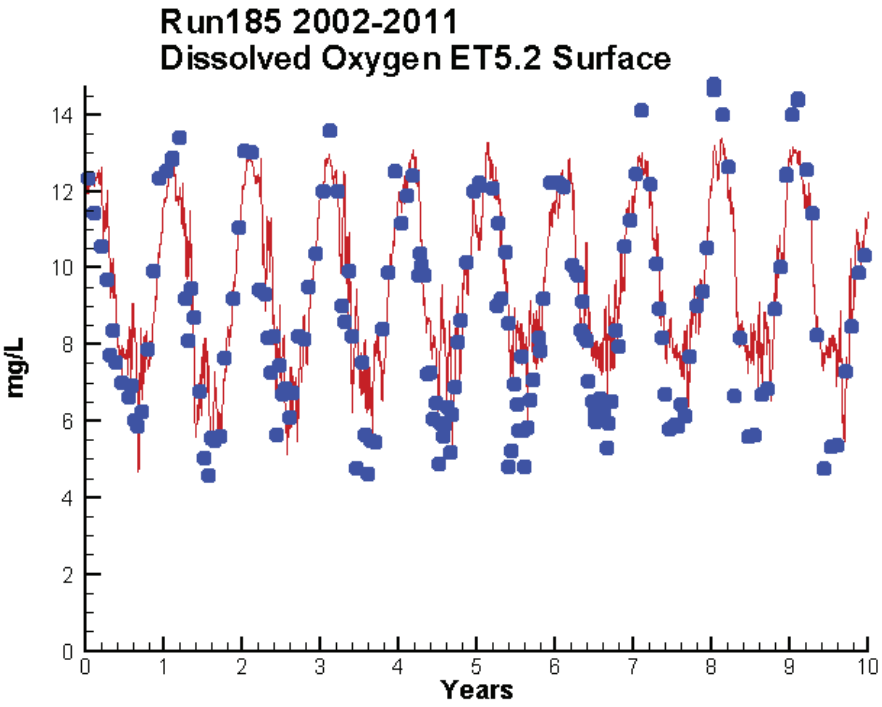






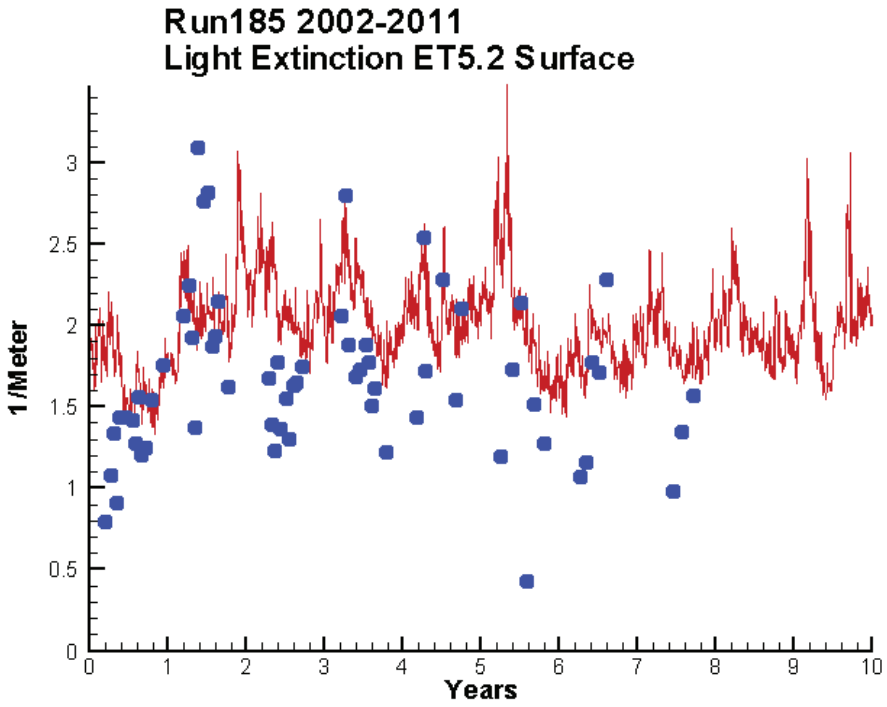
	Mean Difference	Absolute Mean Difference
Chl	-0.9353	7.4493
DIN	0.0740	0.2982
KE	0.3431	0.4568
DIP	0.0210	0.0213
TP	0.0417	0.0421
TN	0.8169	0.8278

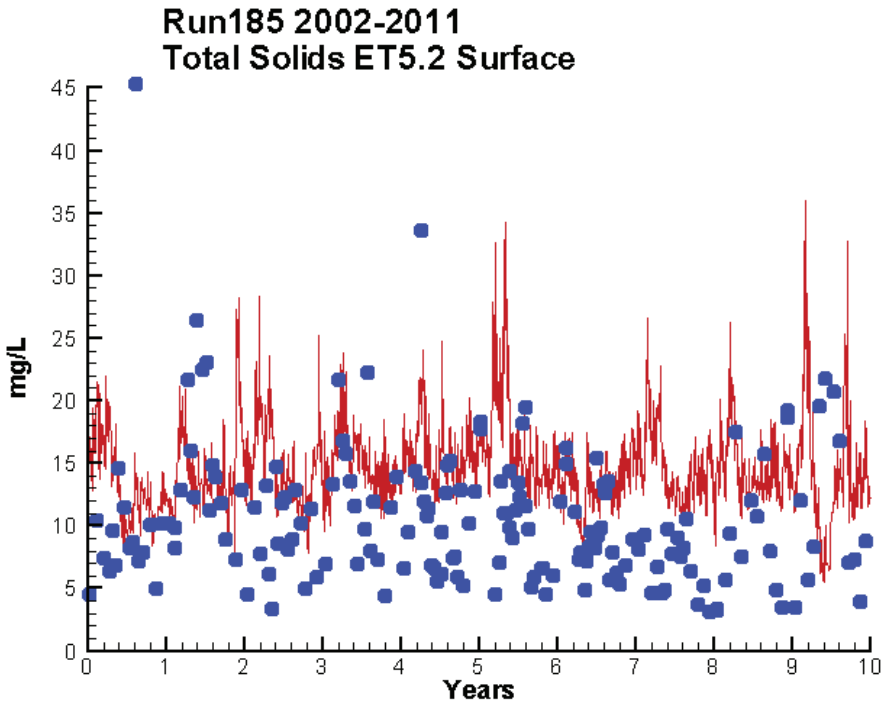
Station ET5.2

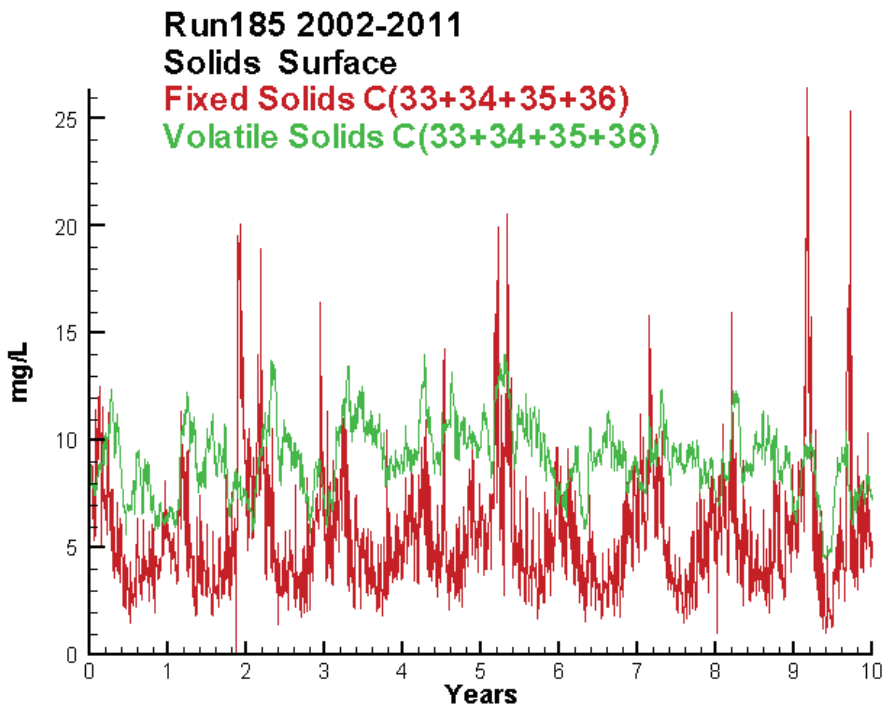


	Mean Difference	Absolute Mean Difference
Top DO	0.6898	1.1523

Station ET5.2

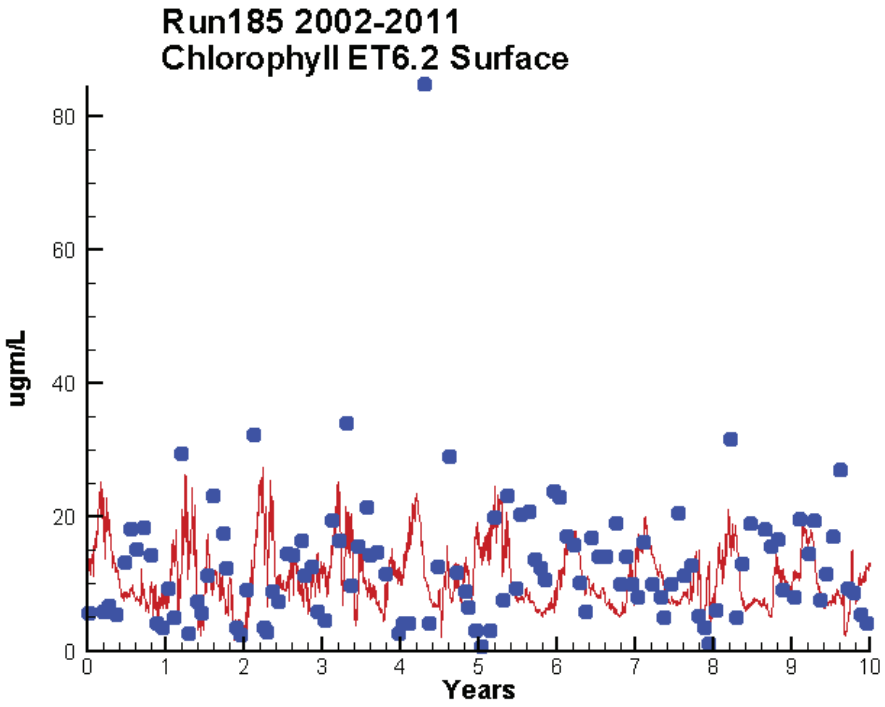


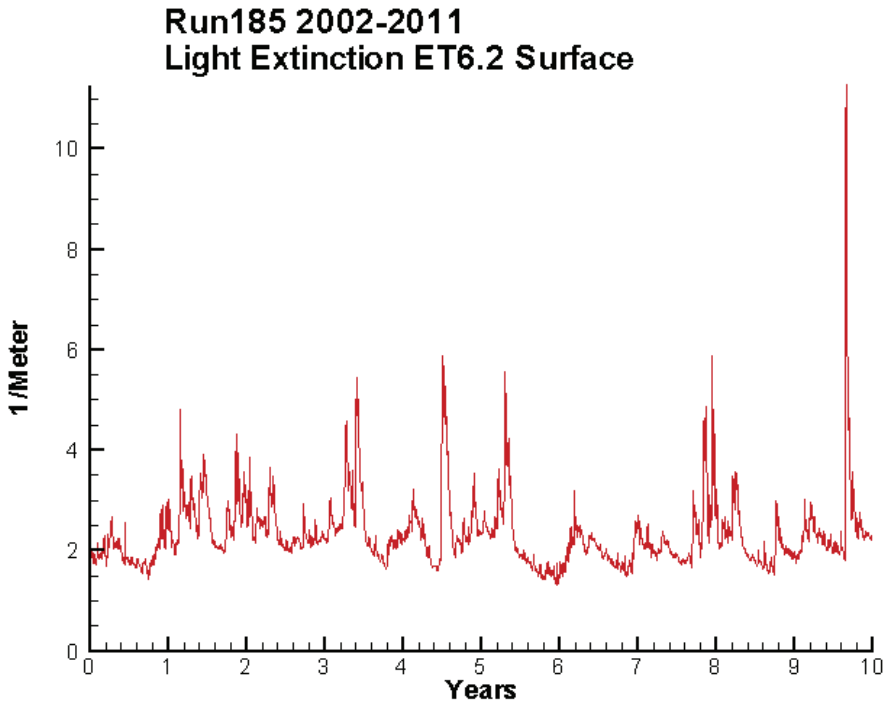


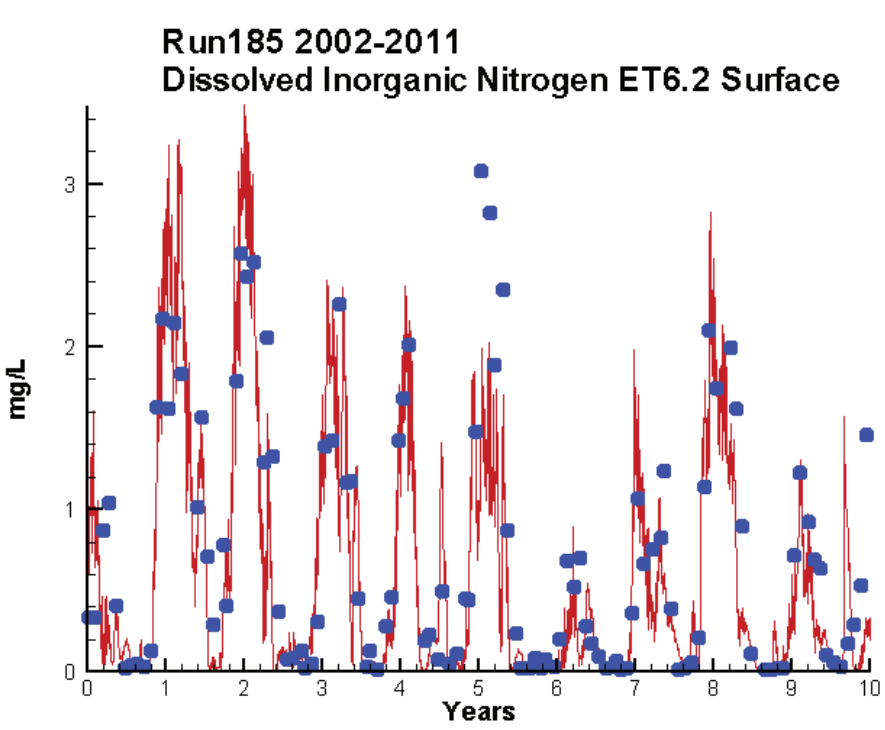


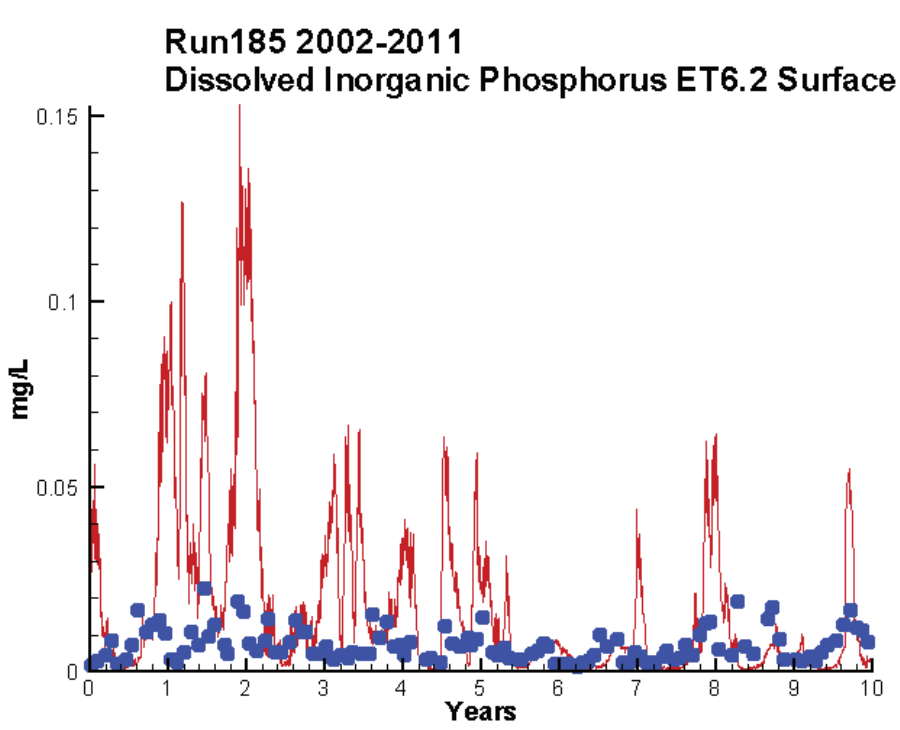
	Mean Difference	Absolute Mean Difference
KE	0.3431	0.4568
TSS	3.8966	5.8983

Station ET6.2

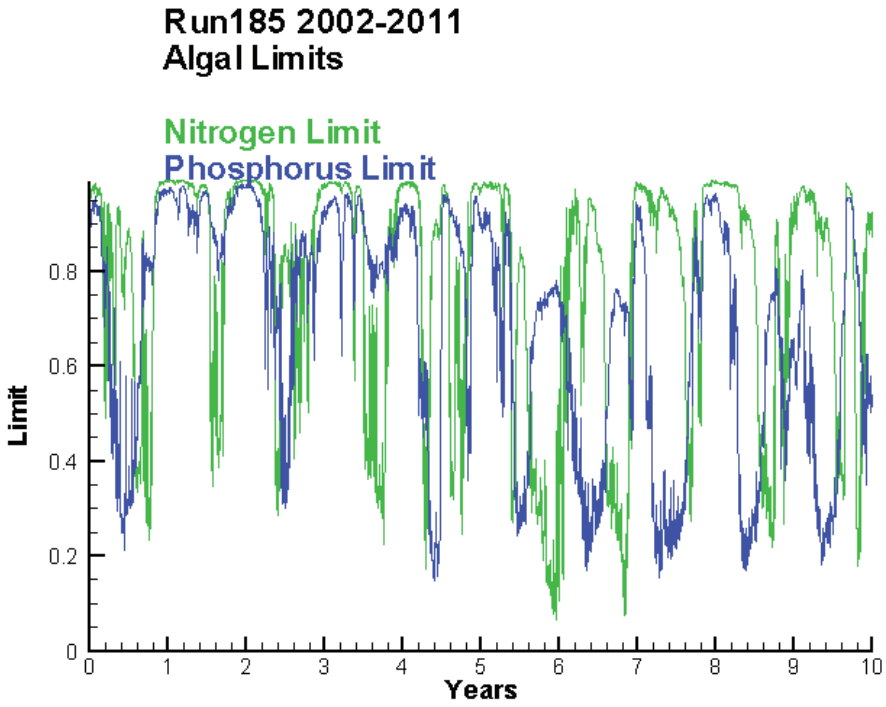


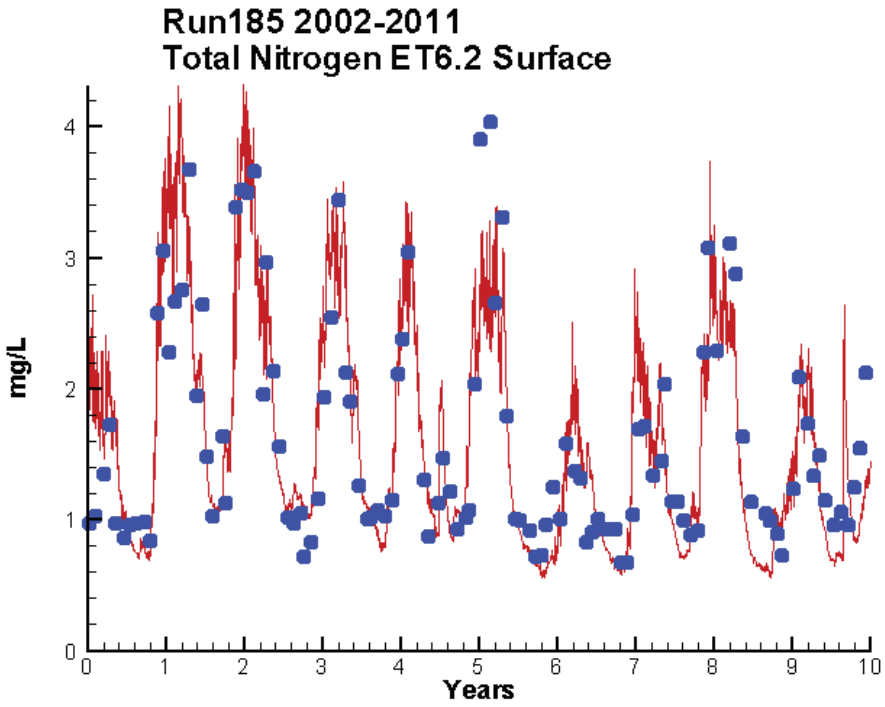


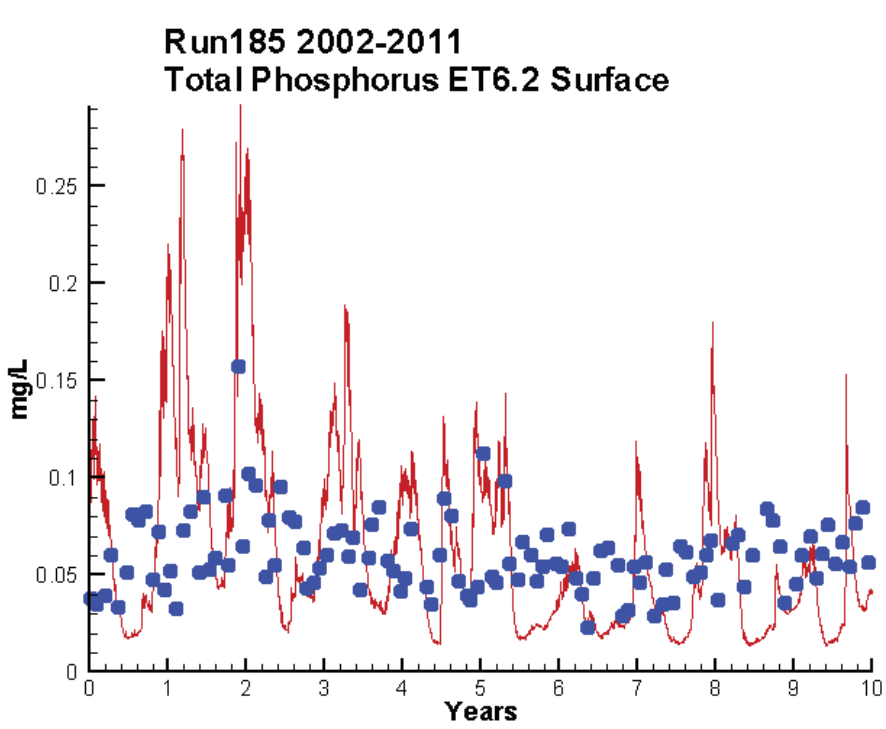




Station ET6.2

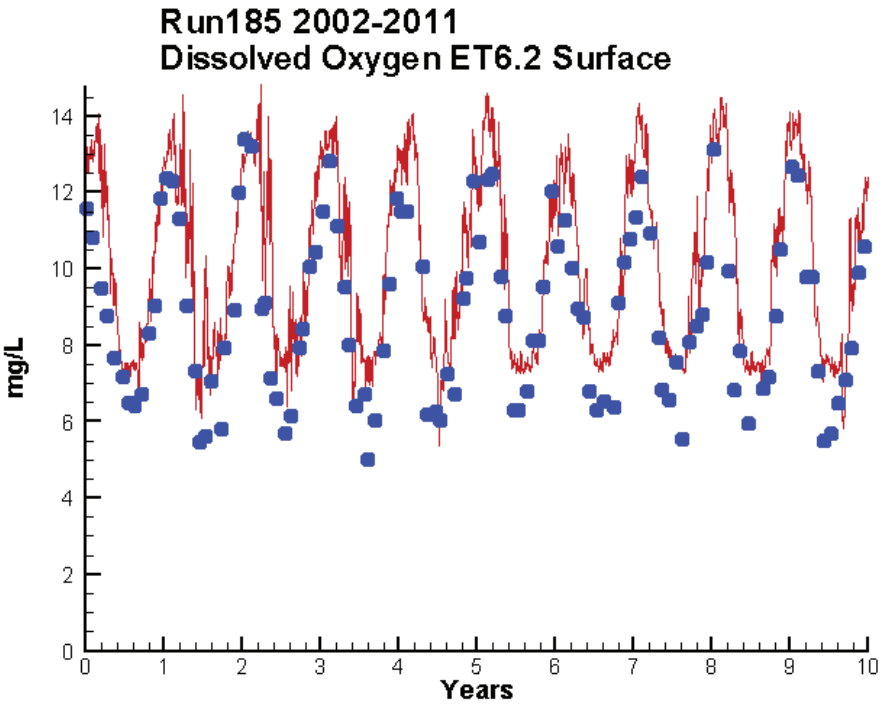






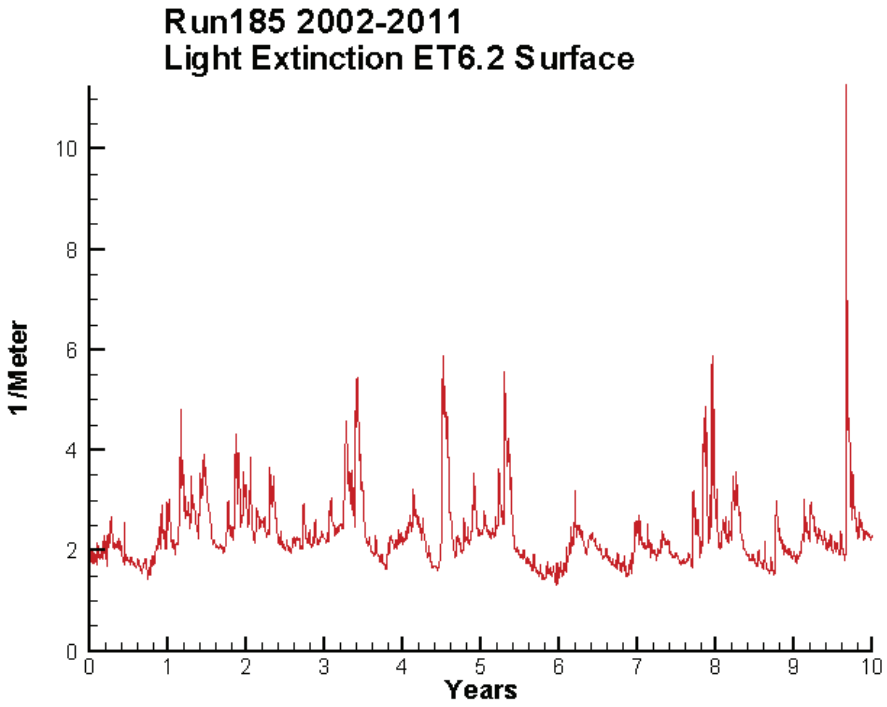
	Mean Difference	Absolute Mean Difference
Chl	-1.7986	7.3721
DIN	-0.1092	0.3182
KE	-0.1092	0.3182
DIP	0.0117	0.0151
TP	0.0039	0.0344
TN	0.0430	0.3705

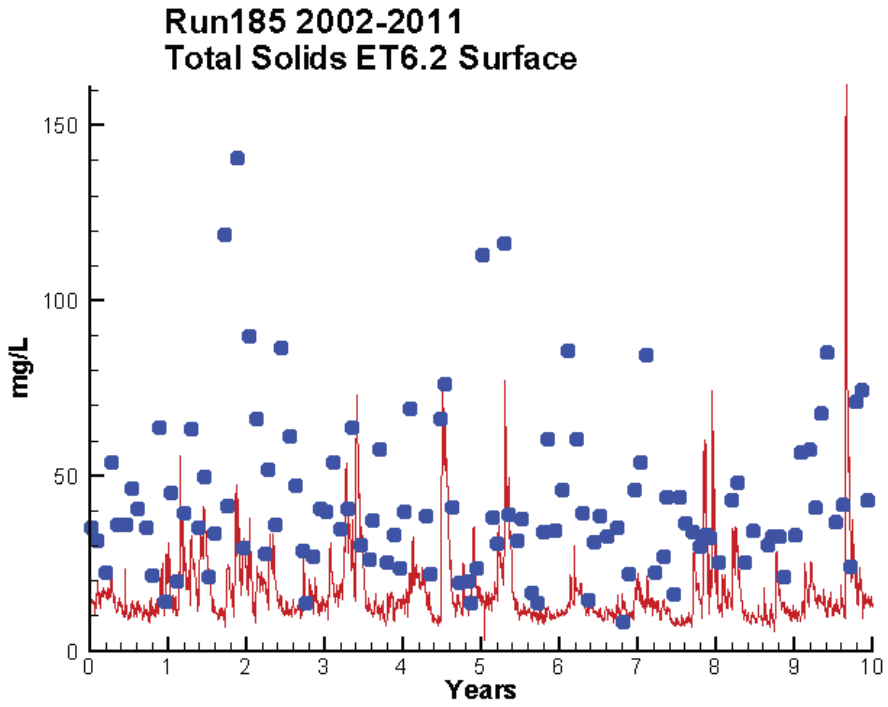
Station ET6.2

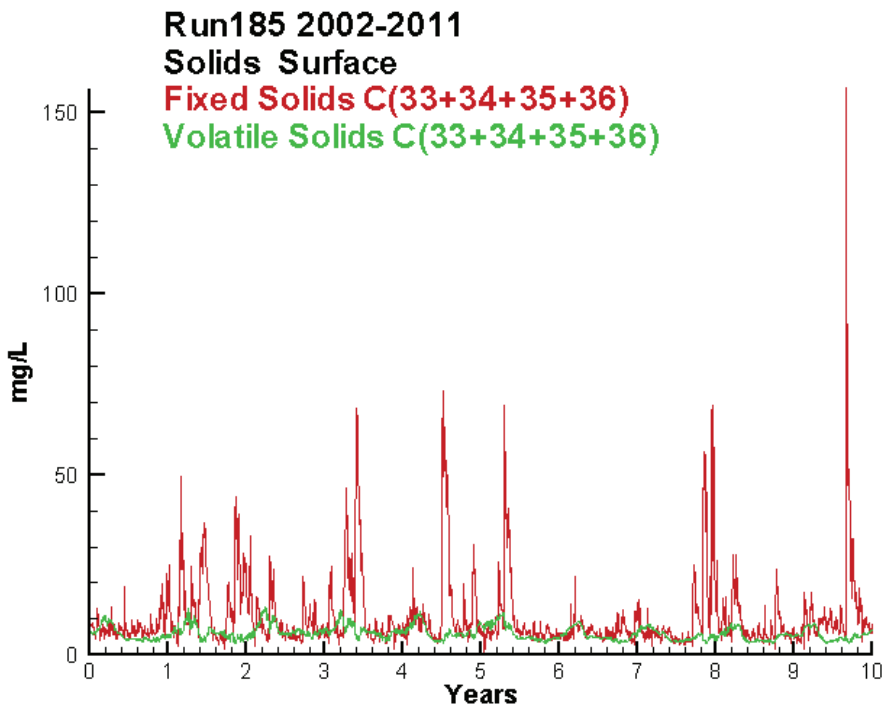


	Mean Difference	Absolute Mean Difference
Top DO	1.3006	1.3576

Station ET6.2

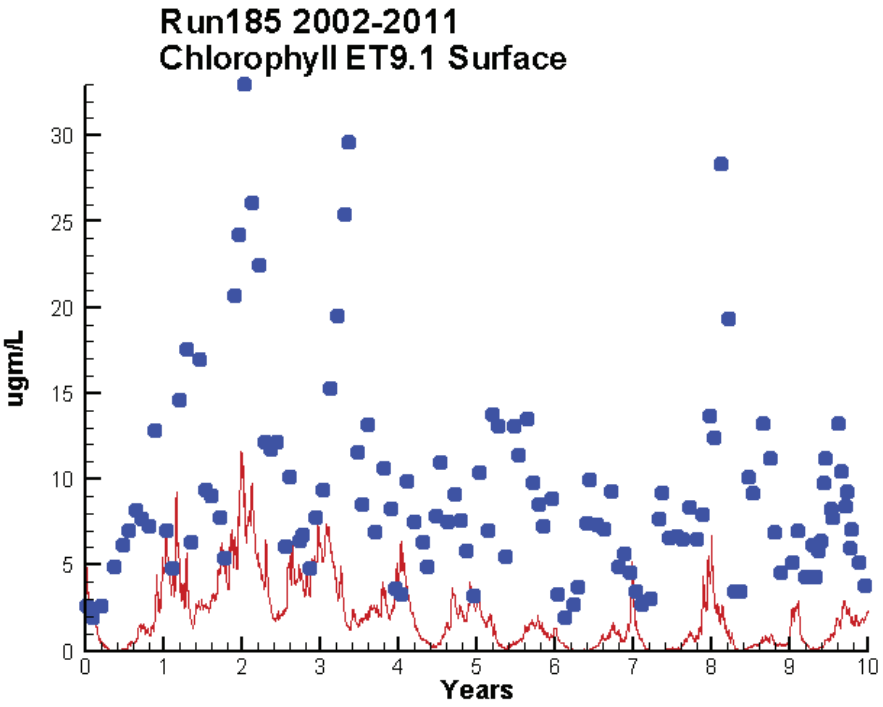


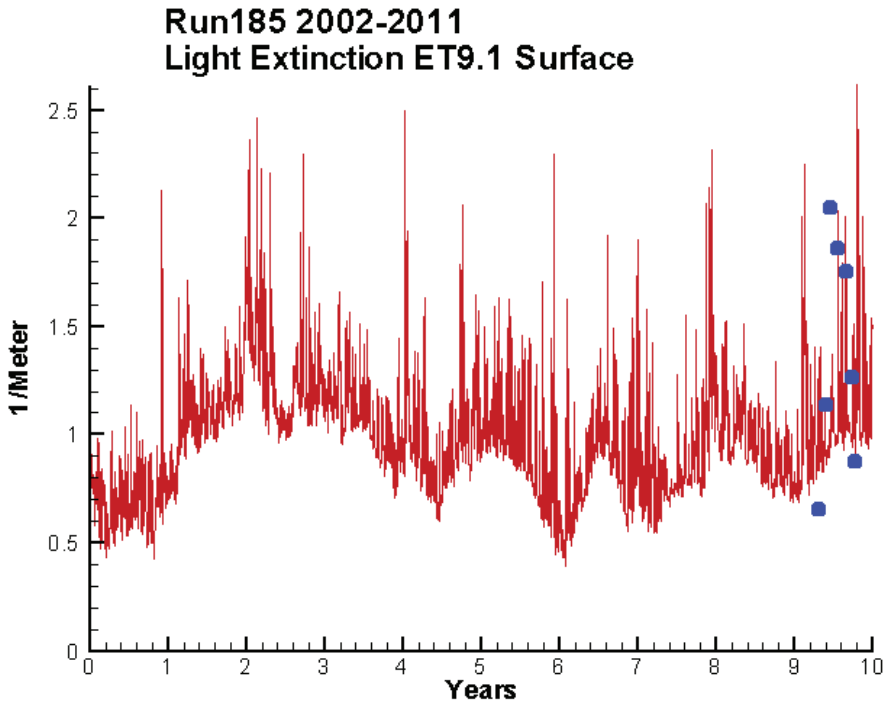


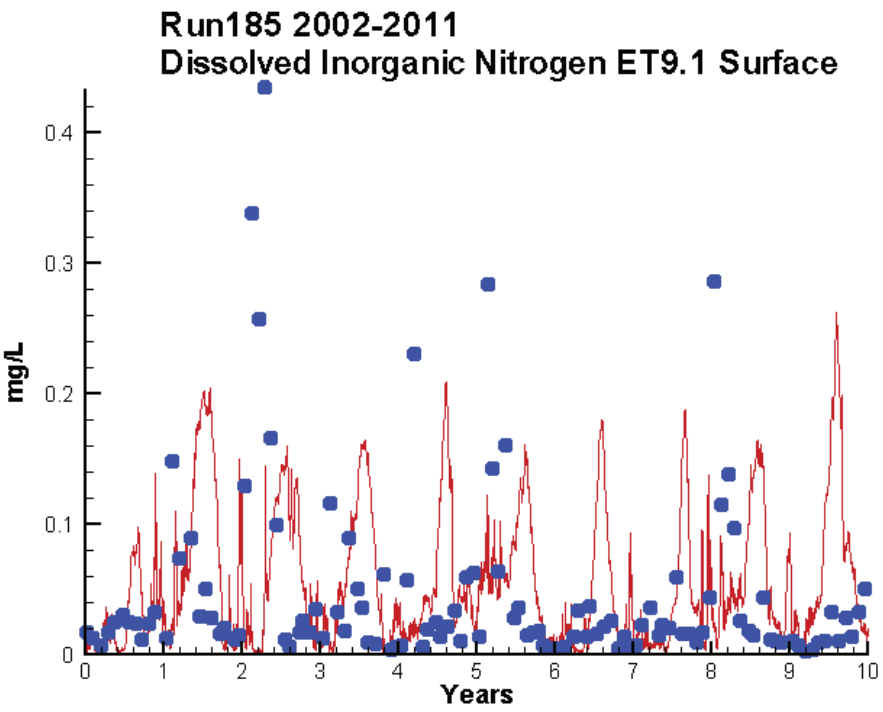


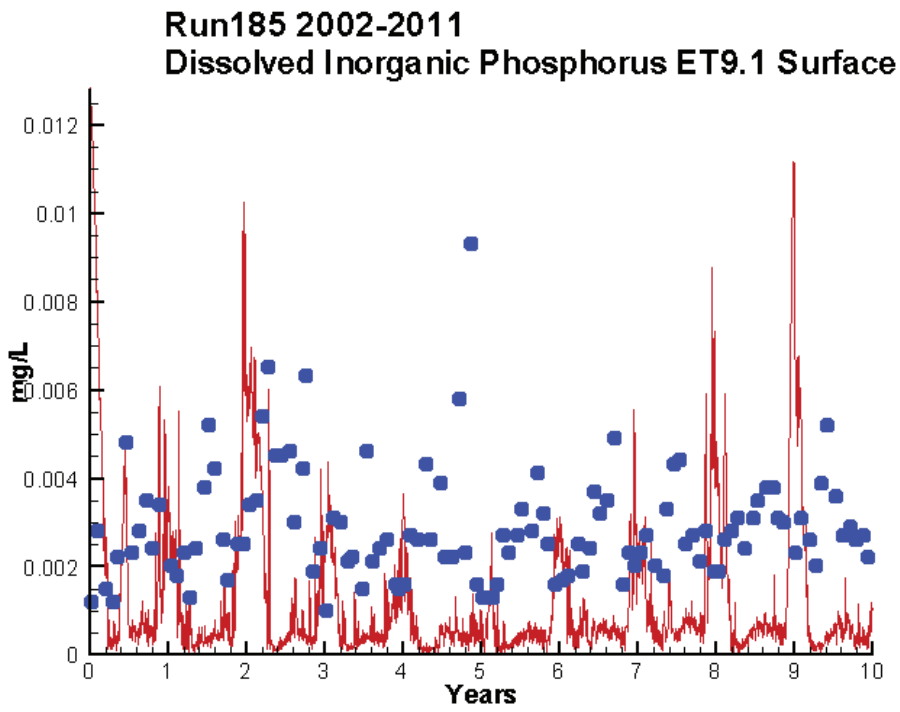
	Mean Difference	Absolute Mean Difference
KE	0.0430	0.3705
TSS	-26.0530	26.3530

Station ET9.1

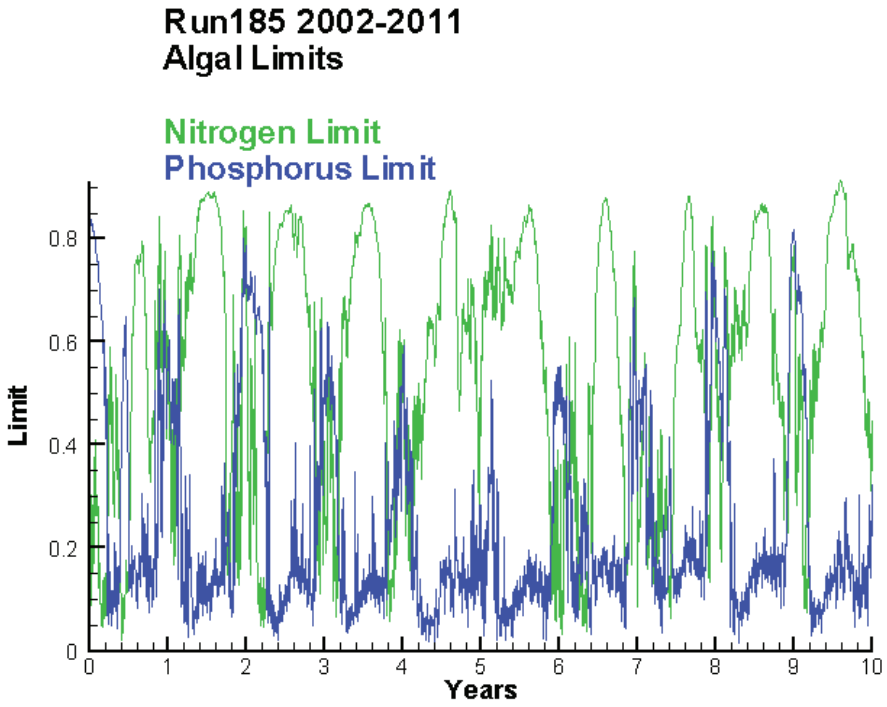


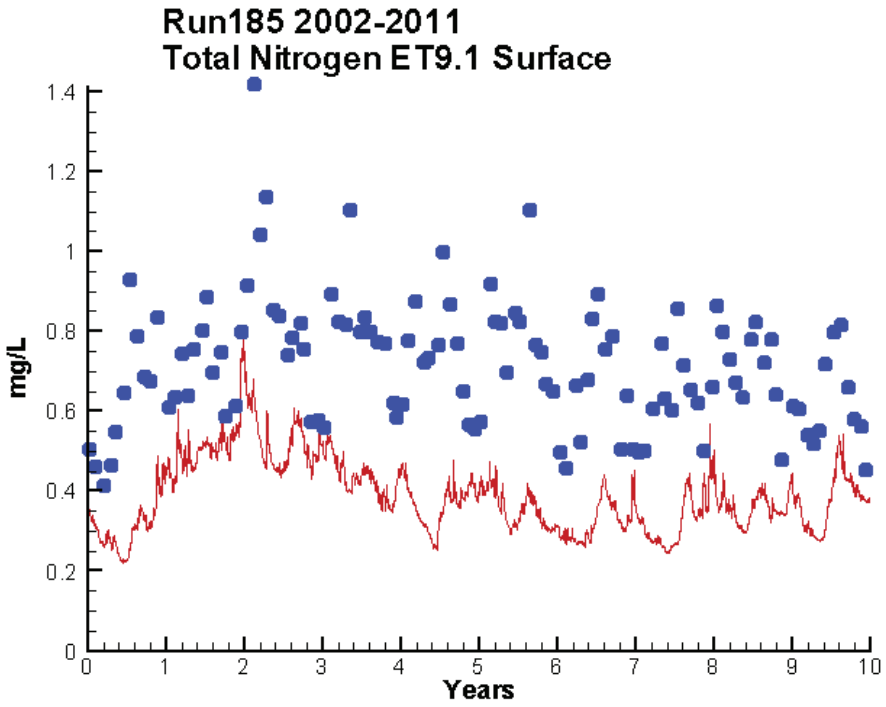


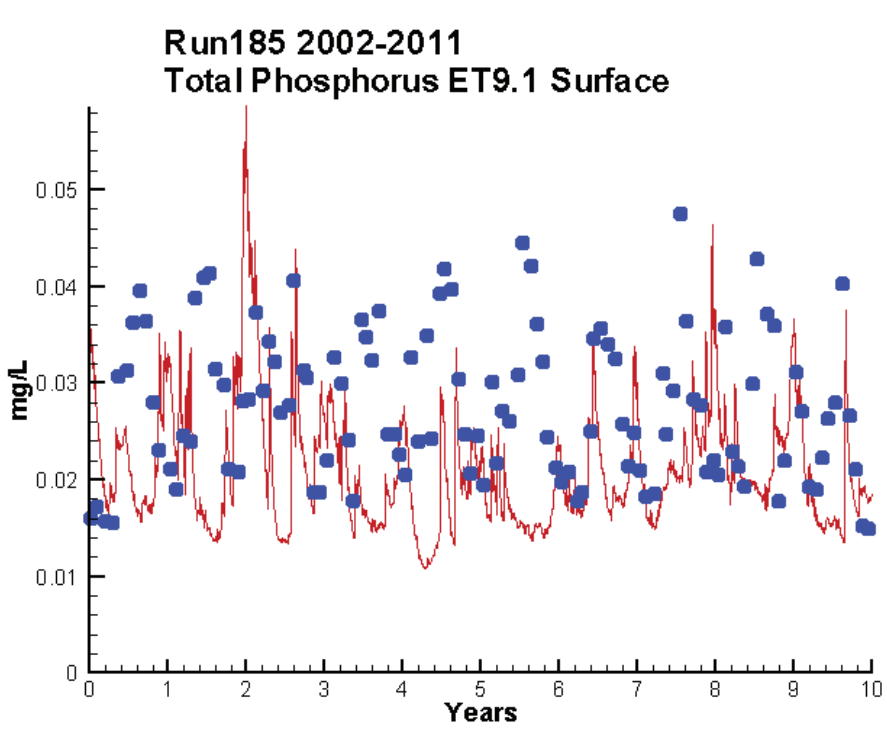




Station ET9.1

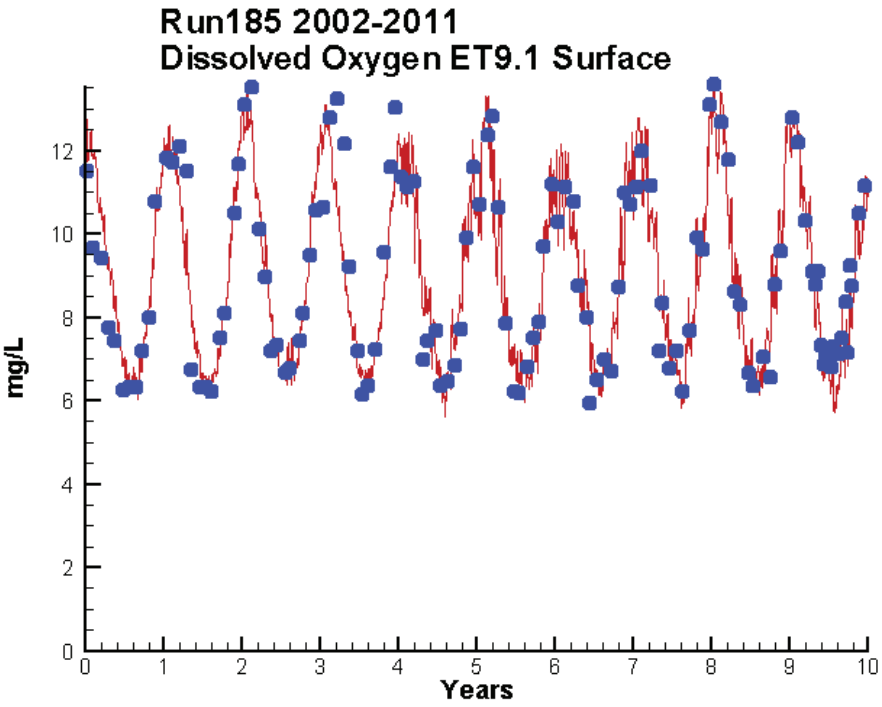






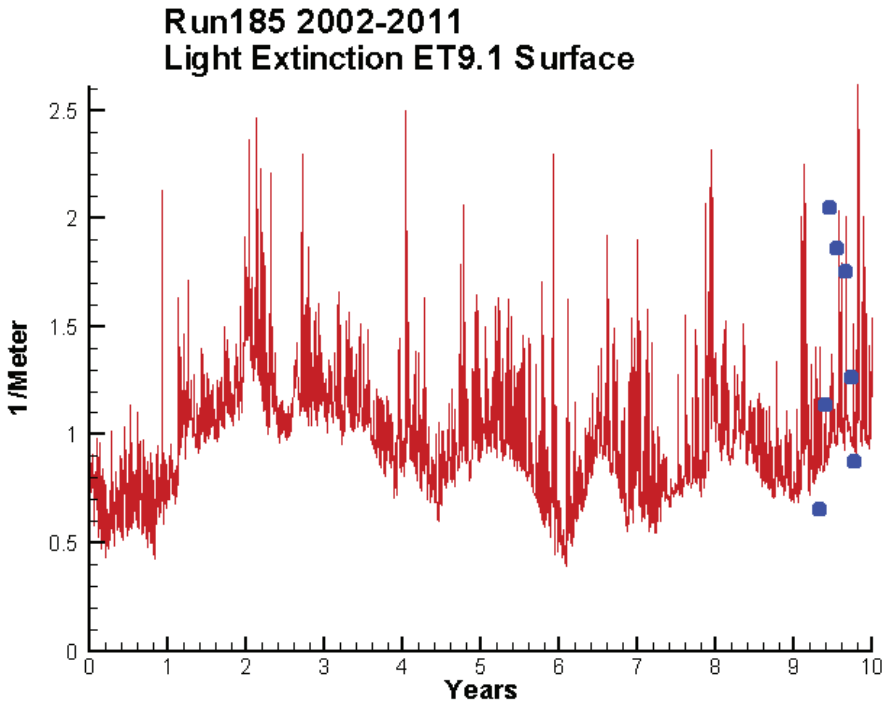
	Mean Difference	Absolute Mean Difference
Chl	-7.2072	7.2649
DIN	0.0108	0.0601
KE	-0.3511	0.4221
DIP	-0.0016	0.0024
TP	-0.0065	0.0097
TN	-0.3234	0.3234

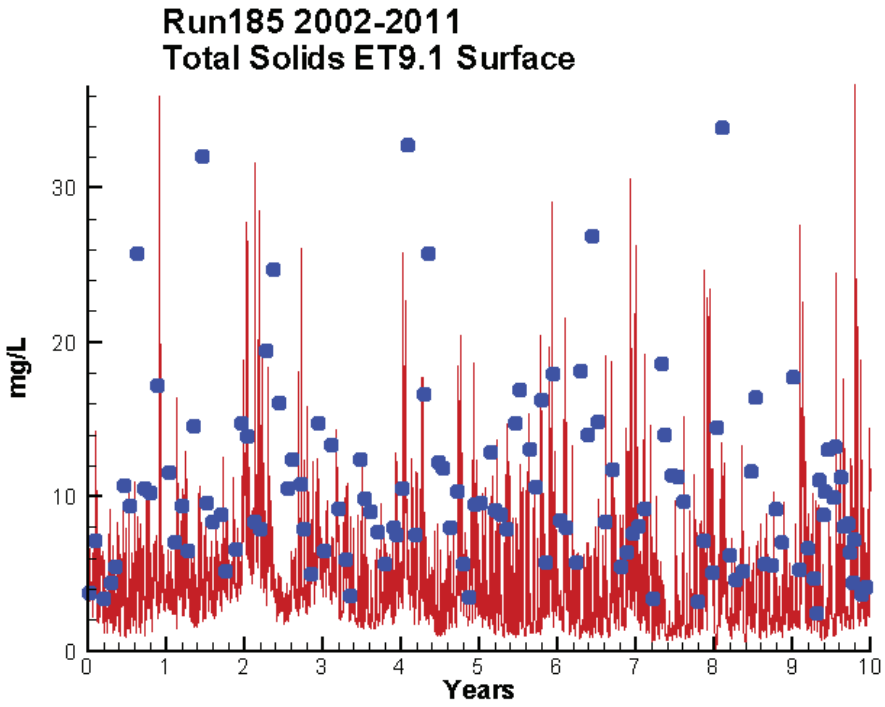
Station ET9.1

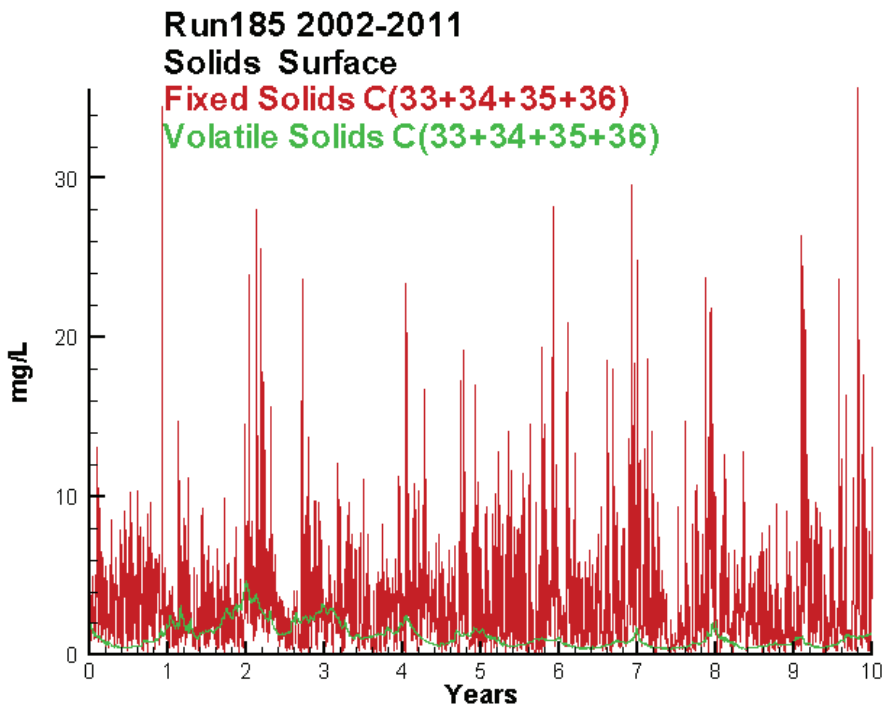


	Mean Difference	Absolute Mean Difference
Top DO	-0.0224	0.5806

Station ET9.1

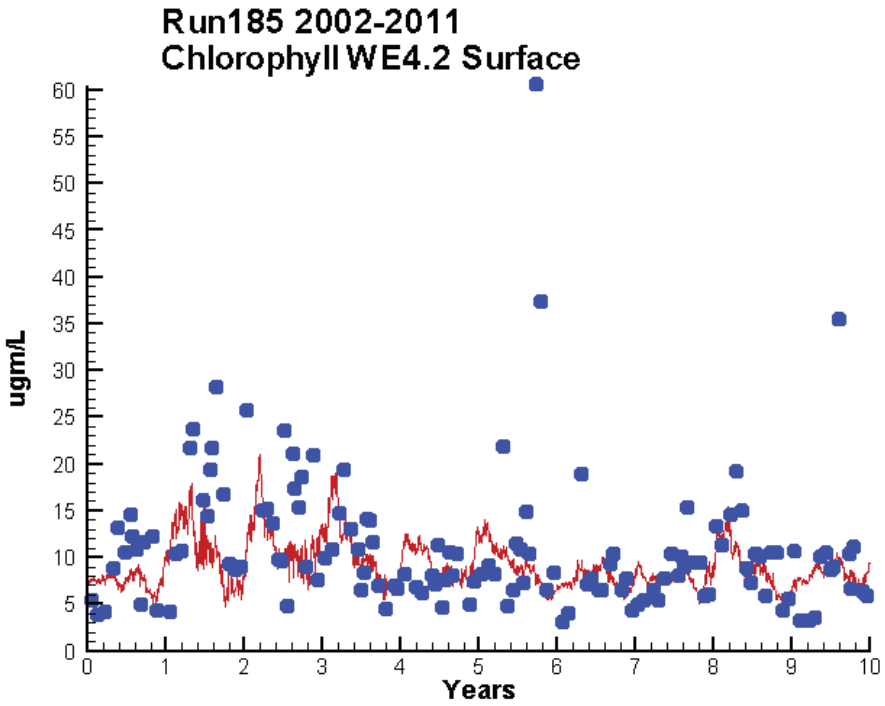


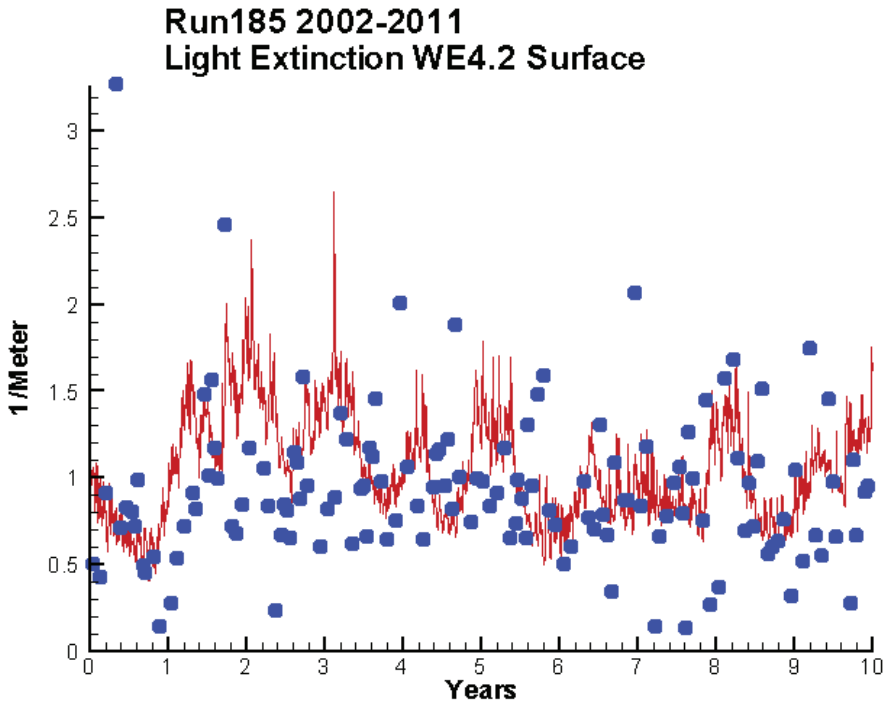


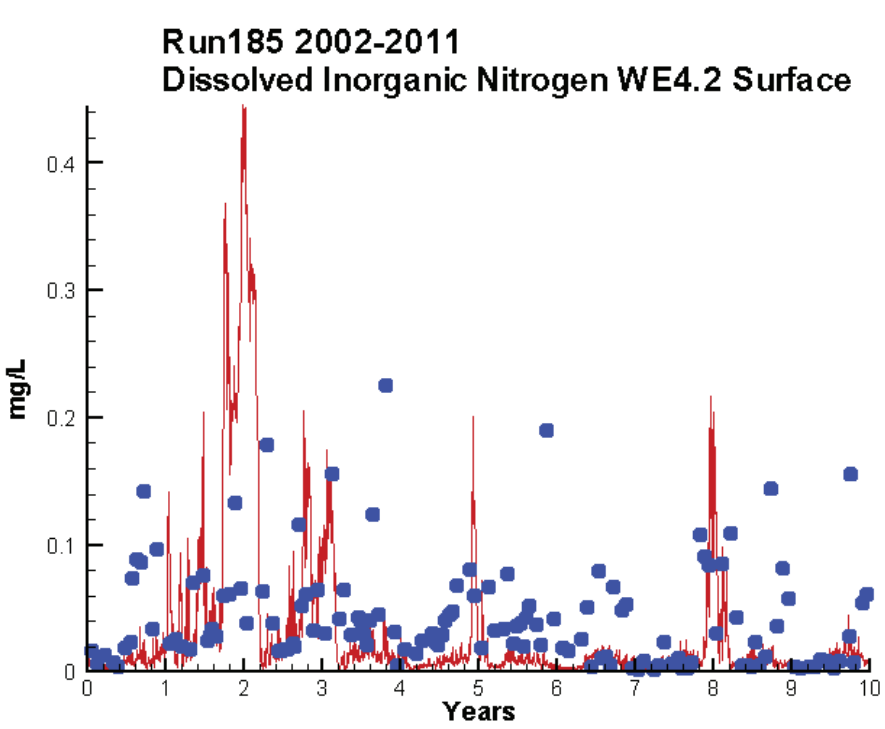


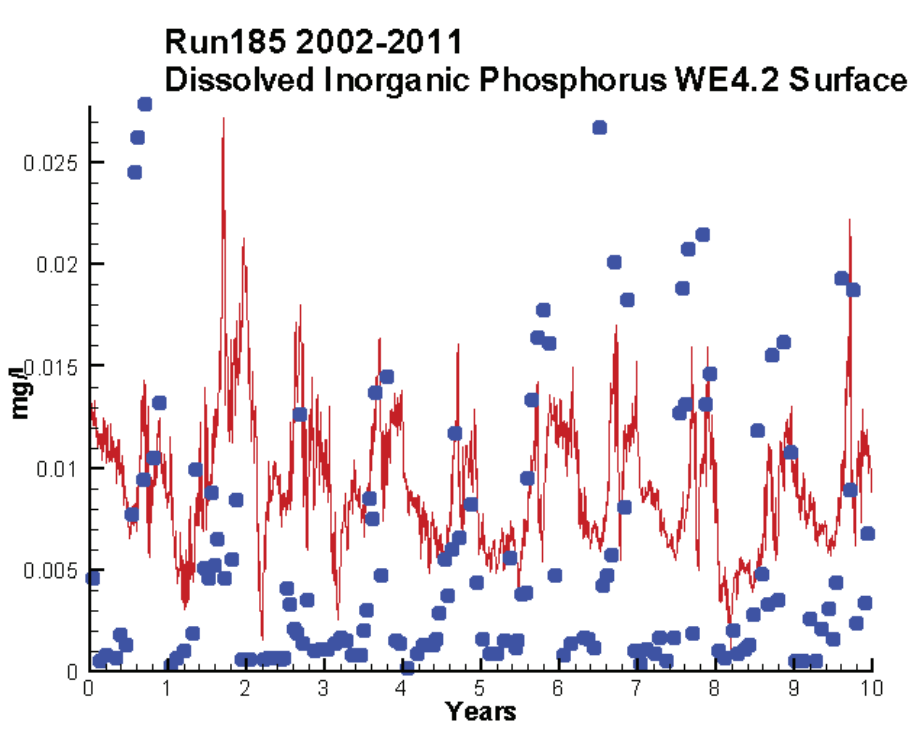
	Mean Difference	Absolute Mean Difference
KE	-0.3511	0.4221
TSS	-5.8125	6.9923

Station WE4.2

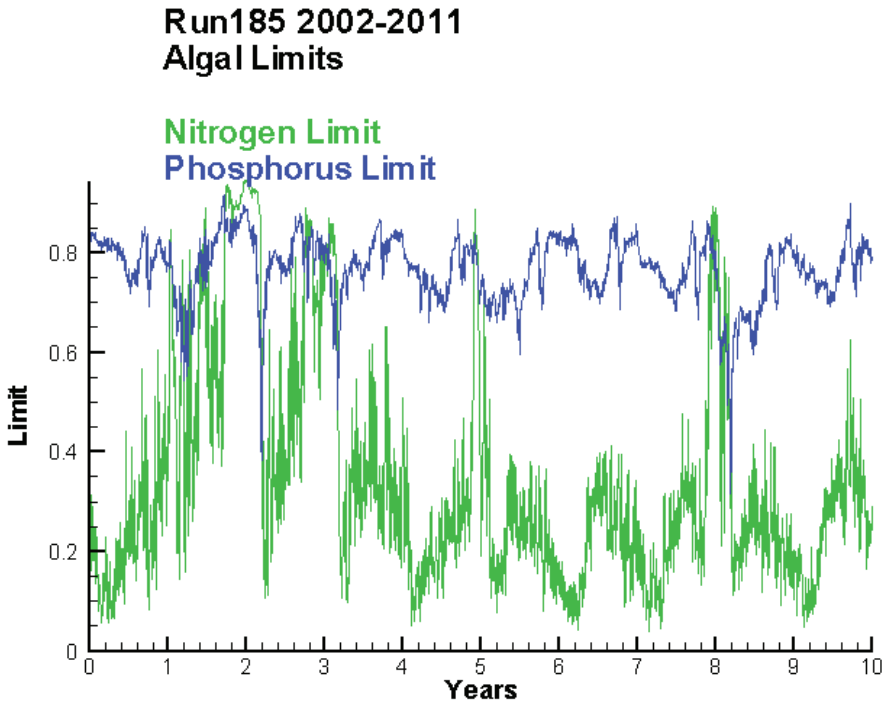


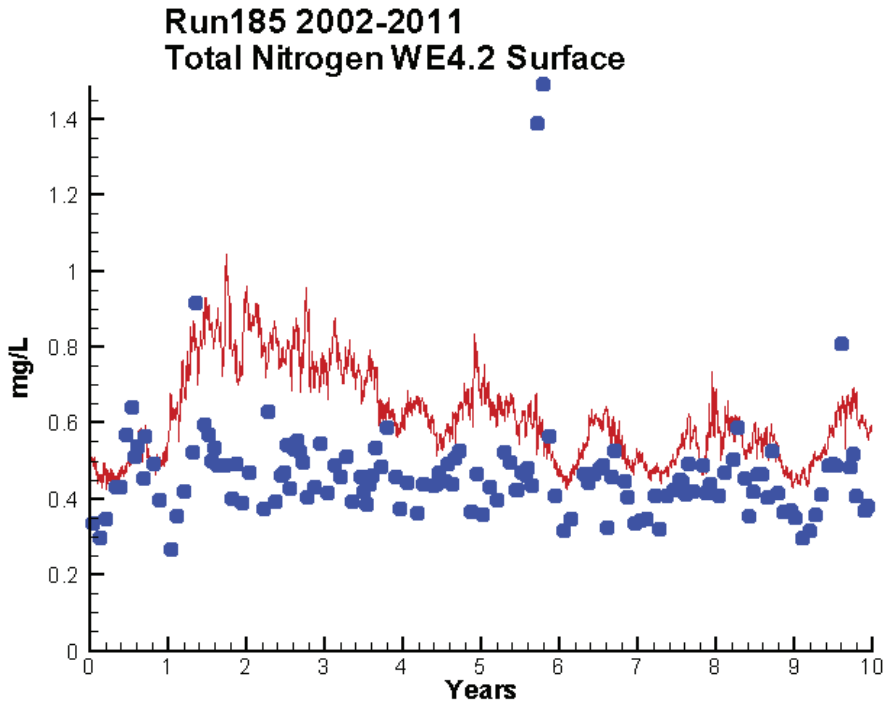


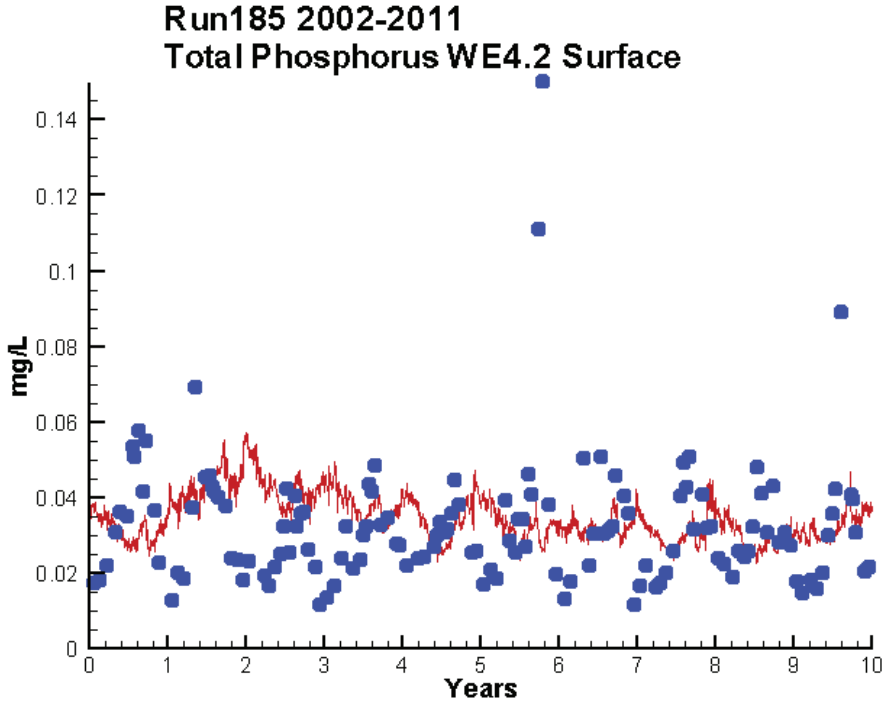




Station WE4.2

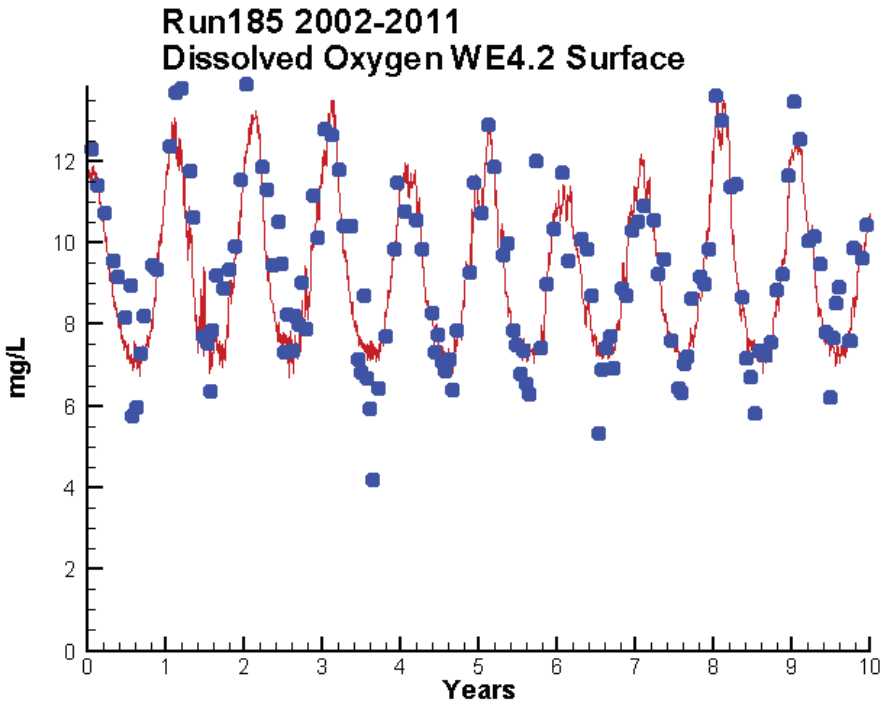




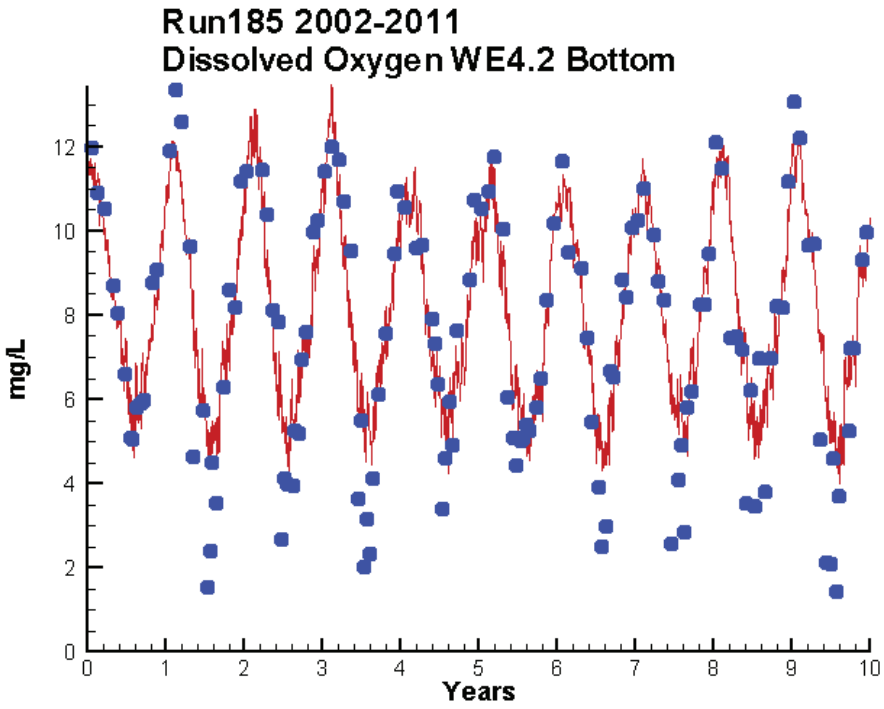


	Mean Difference	Absolute Mean Difference
Chl	-1.8632	4.2241
DIN	-0.0130	0.0386
KE	0.1089	0.3833
DIP	0.0033	0.0063
TP	0.0021	0.0129
TN	0.1609	0.1932

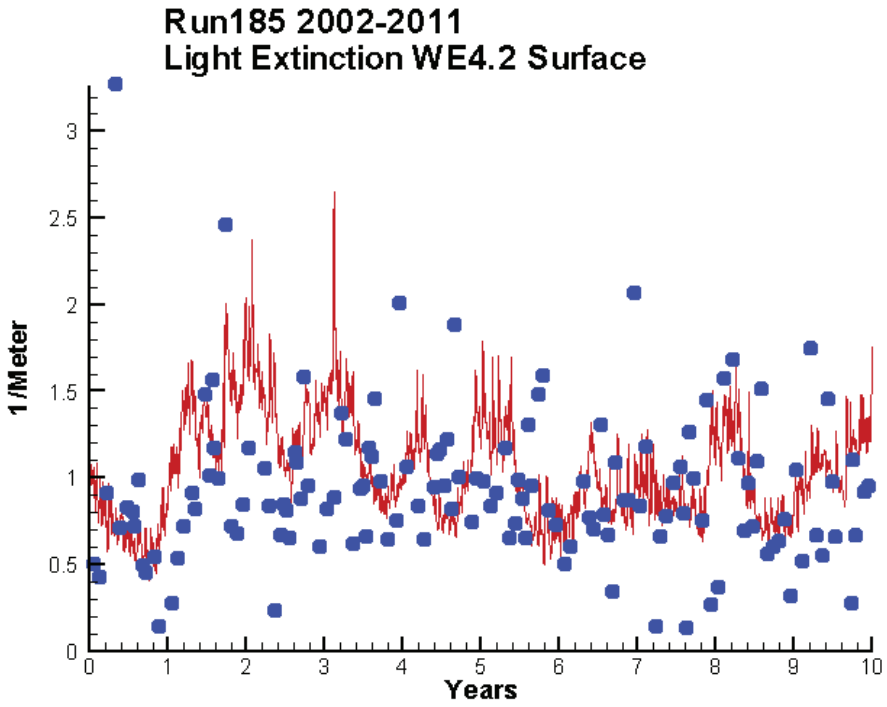
Station WE4.2

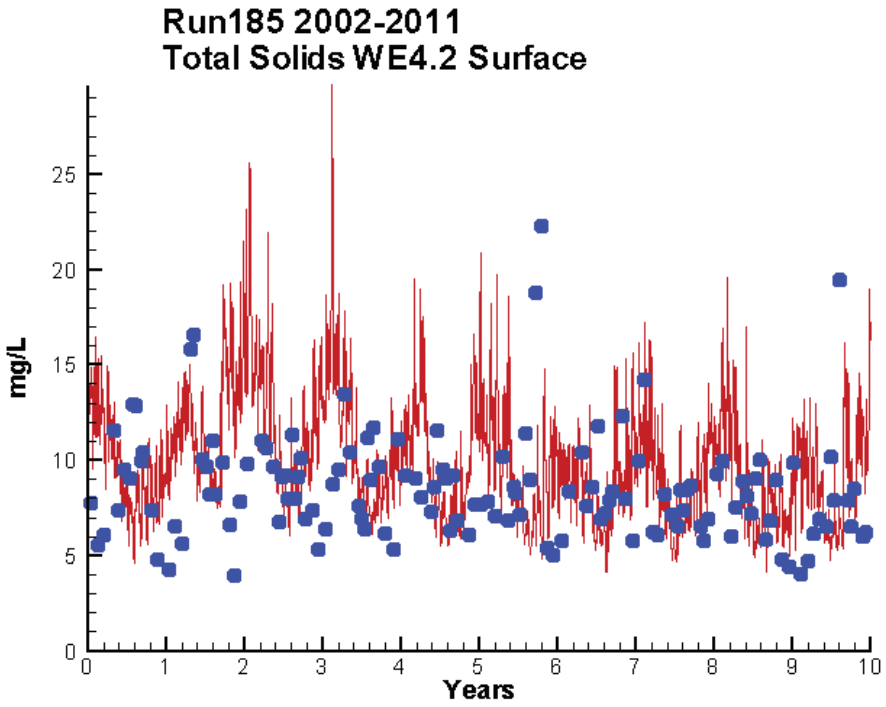


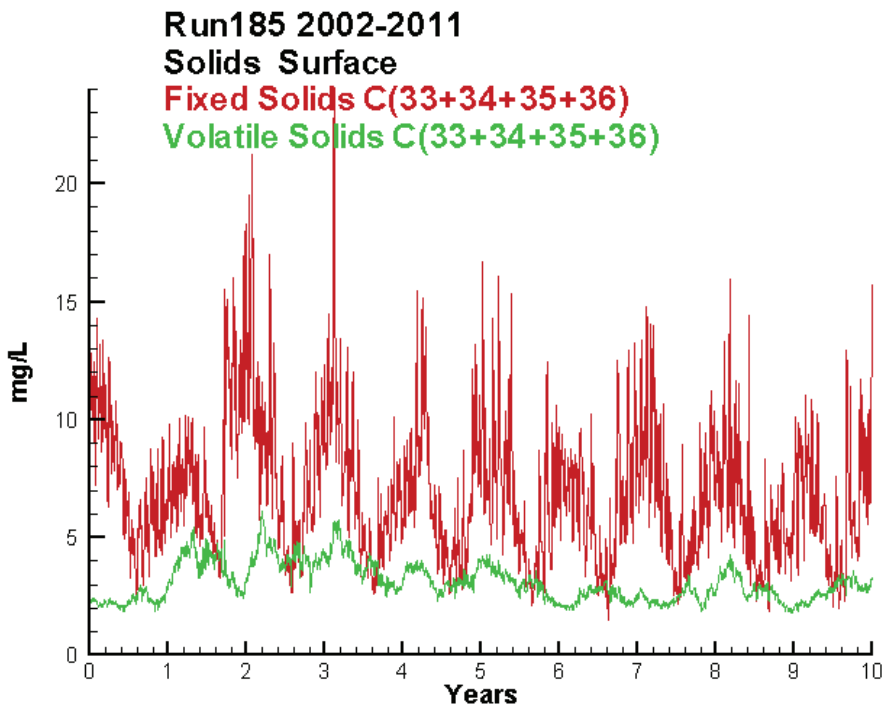
	Mean Difference	Absolute Mean Difference
Top DO	-0.1894	0.7562
Bot DO	0.3797	0.9836



Station WE4.2



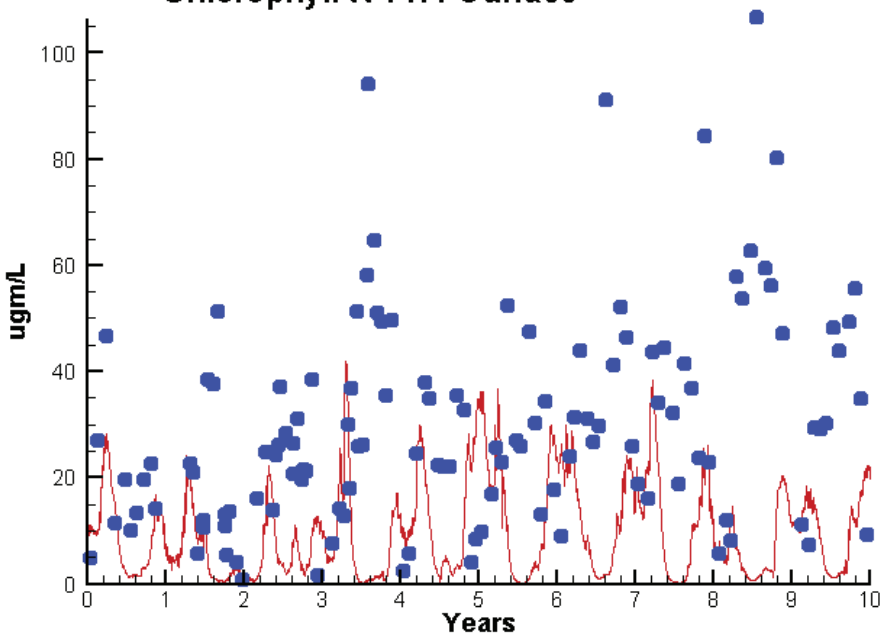




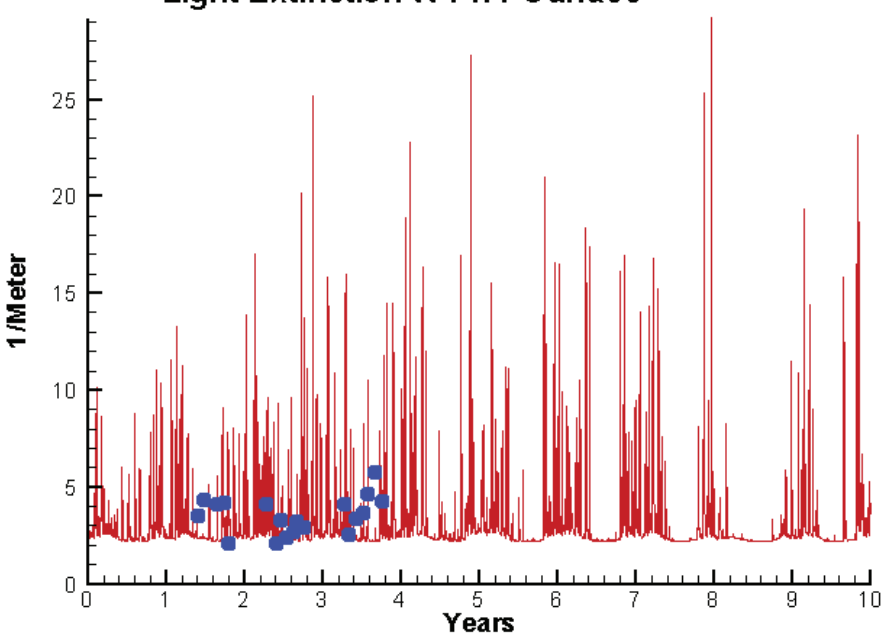
	Mean Difference	Absolute Mean Difference
KE	0.1089	0.3833
TSS	1.0206	3.2212

Station WT1.1

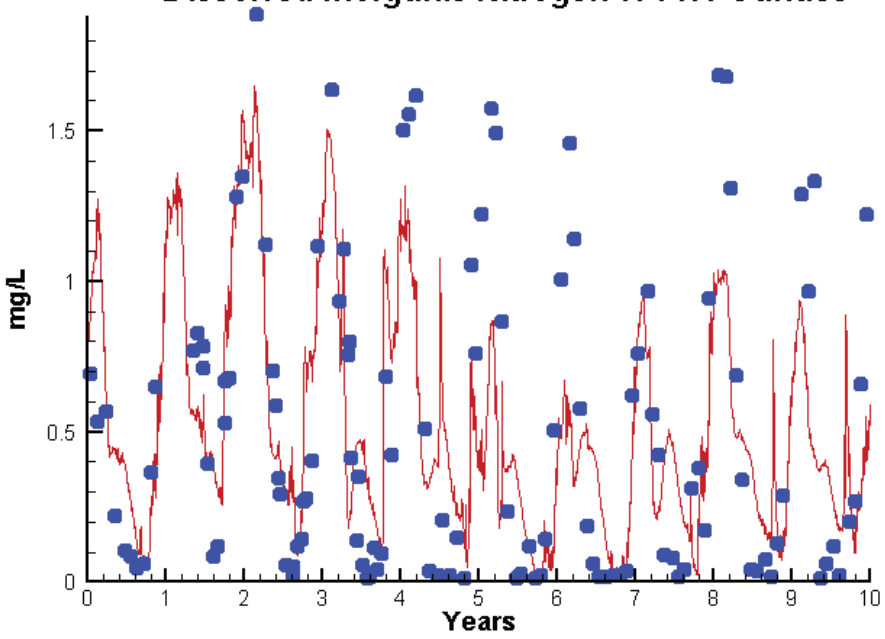
Run185 2002-2011
Chlorophyll WT1.1 Surface



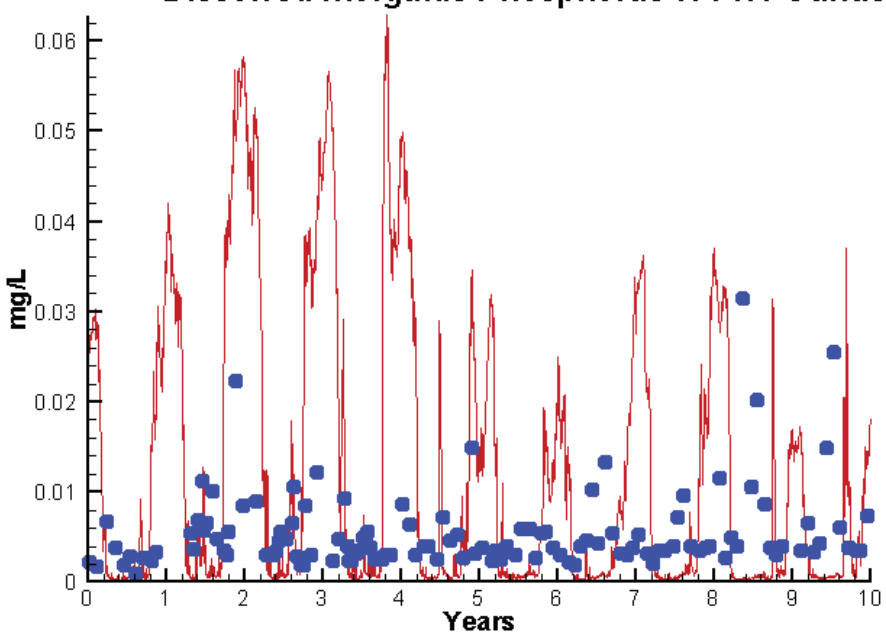
Run185 2002-2011
Light Extinction WT1.1 Surface



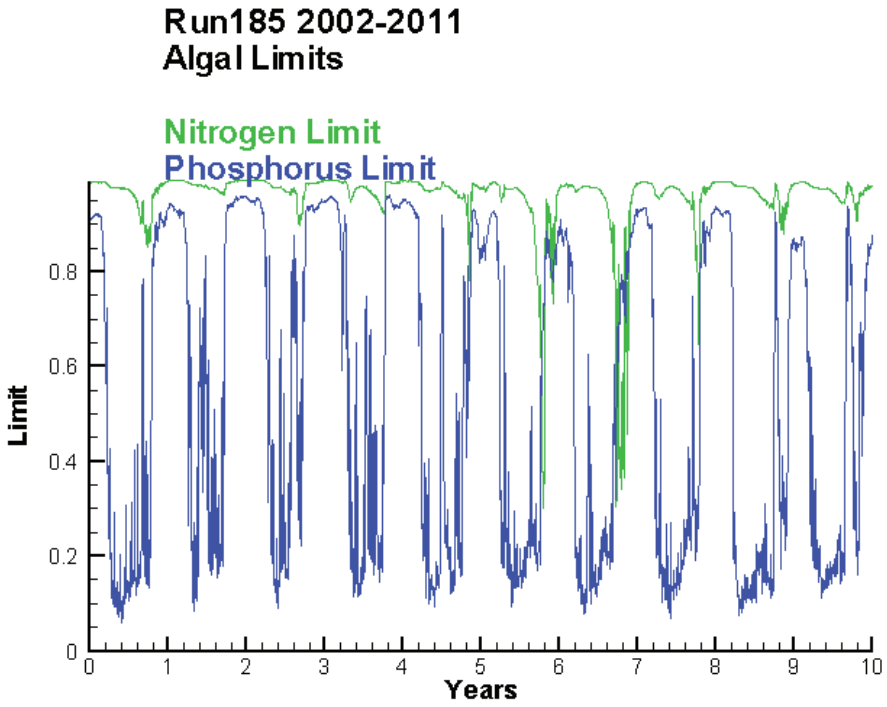
Run185 2002-2011
Dissolved Inorganic Nitrogen WT1.1 Surface

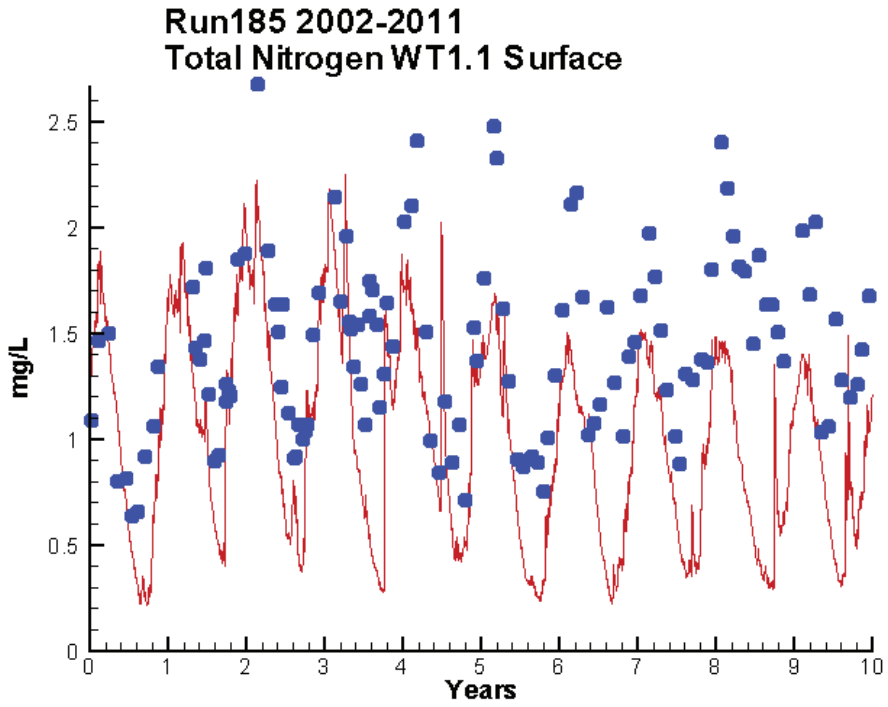


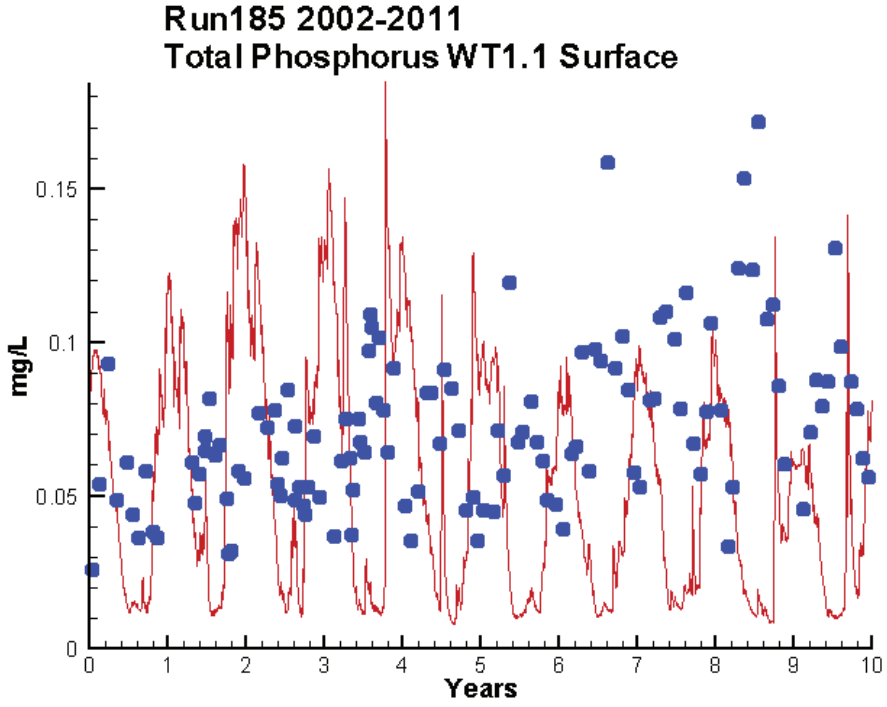
Run185 2002-2011
Dissolved Inorganic Phosphorus WT1.1 Surface



Station WT1.1

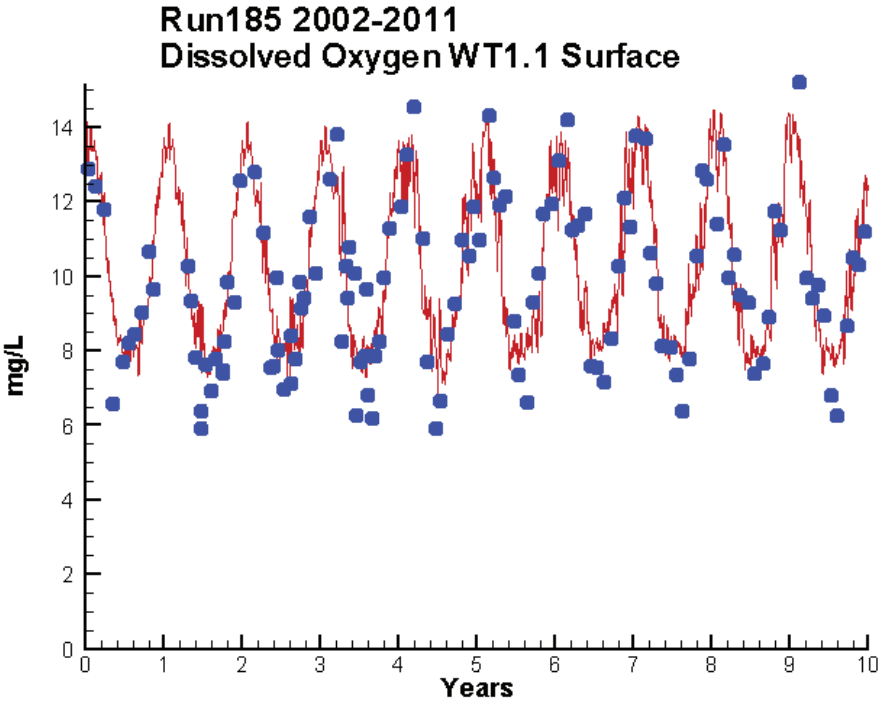






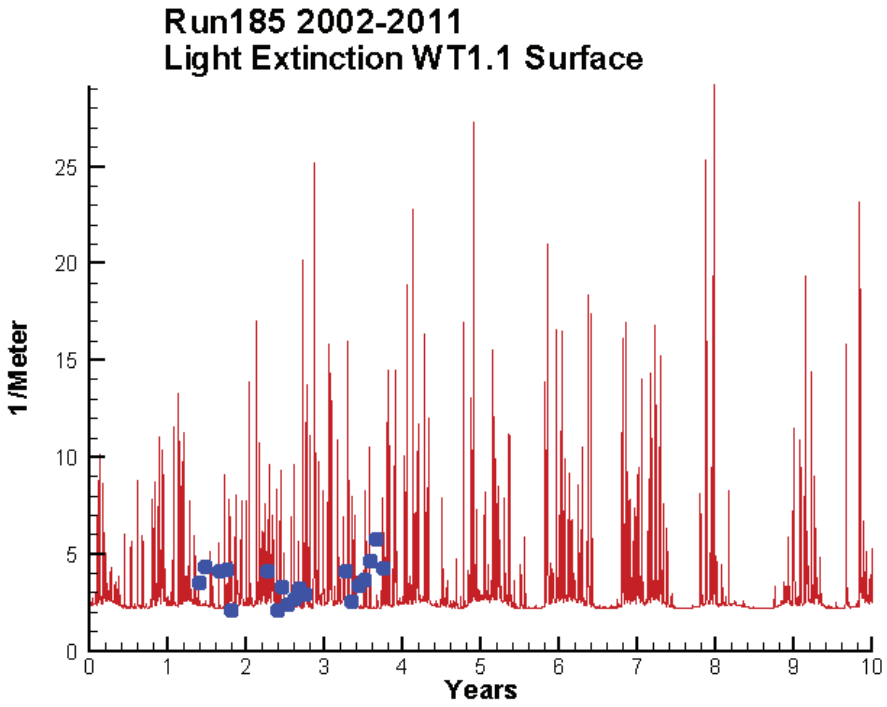
	Mean Difference	Absolute Mean Difference
Chl	-20.1983	23.2407
DIN	-0.0339	0.2770
KE	-0.0746	1.9257
DIP	0.0054	0.0108
TP	-0.0228	0.0487
TN	-0.4905	0.5154

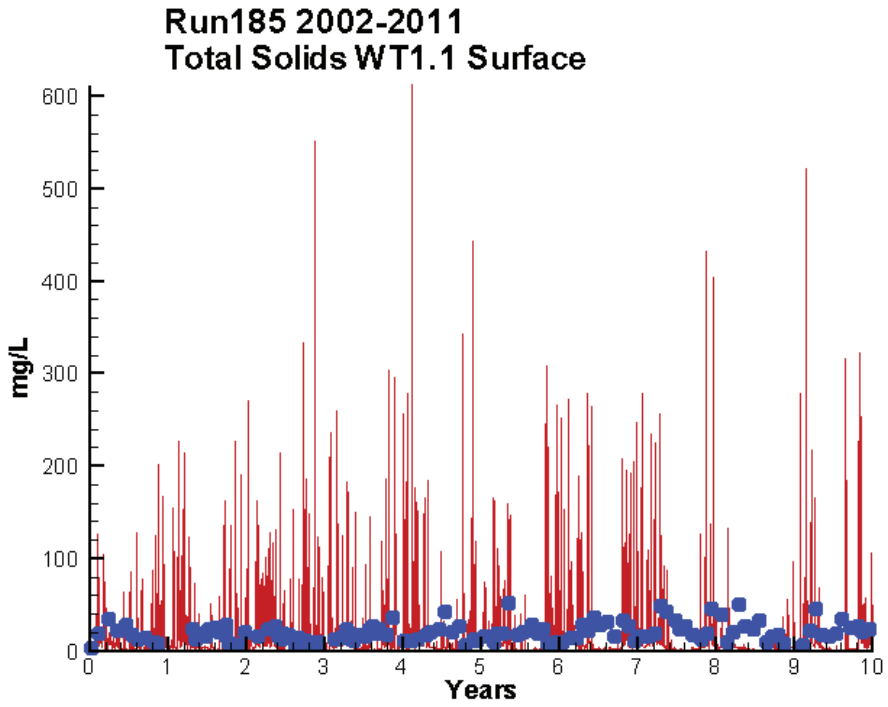
Station WT1.1

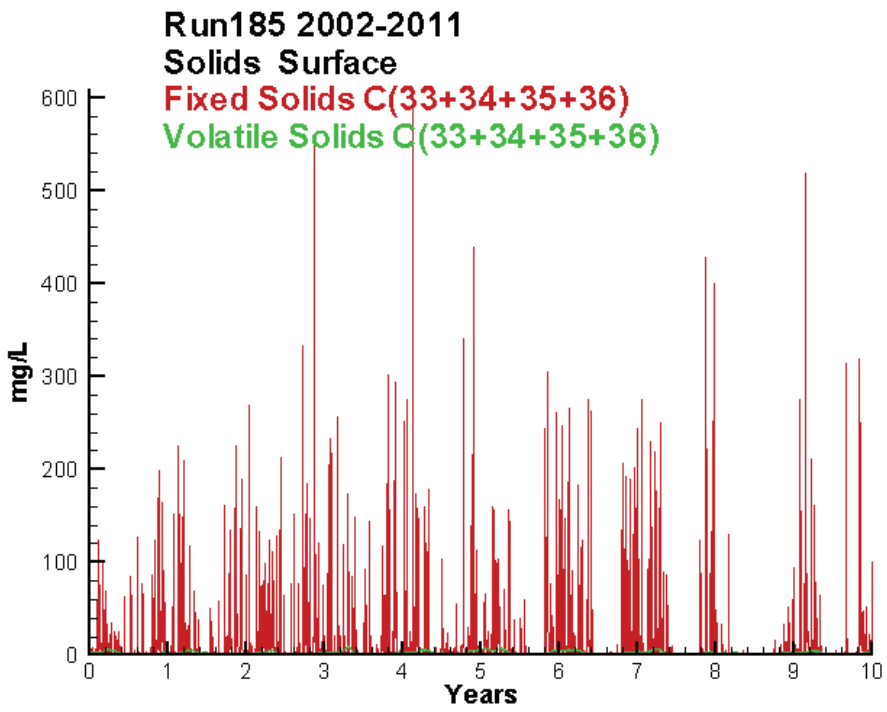


	Mean Difference	Absolute Mean Difference
Top DO	0.1944	0.9707

Station WT1.1

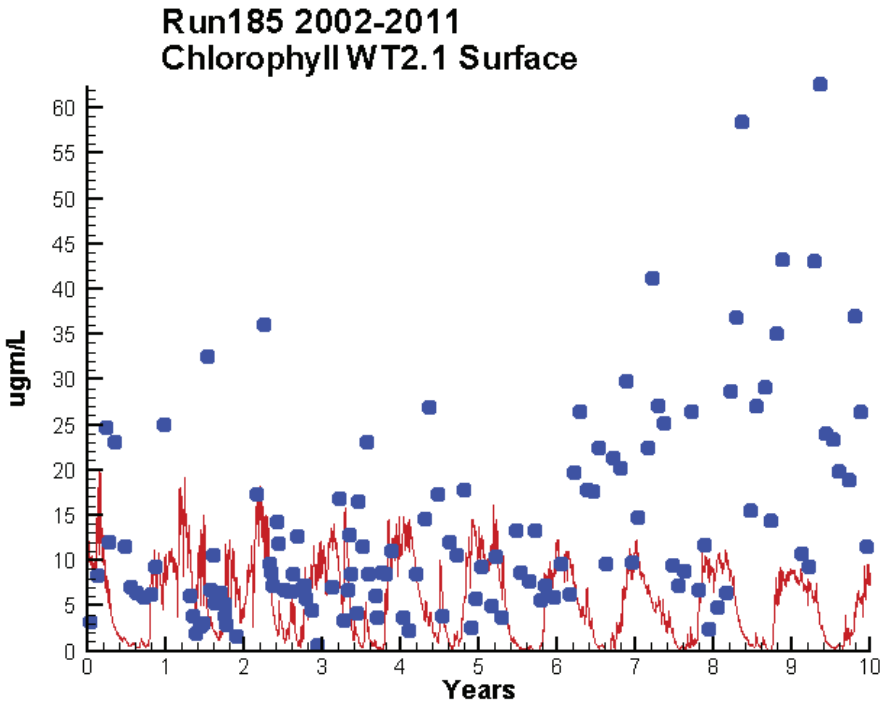


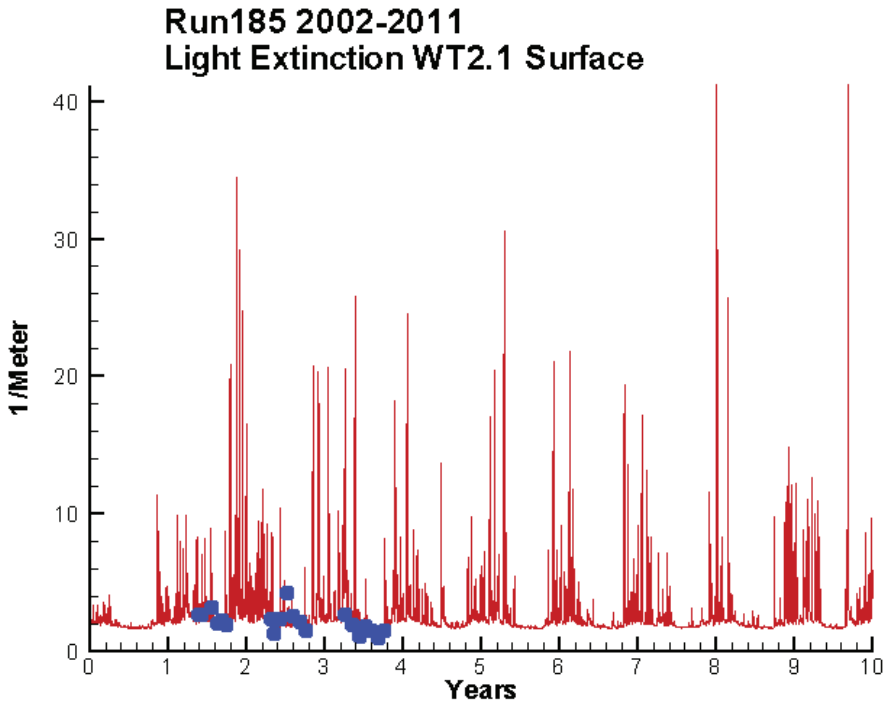


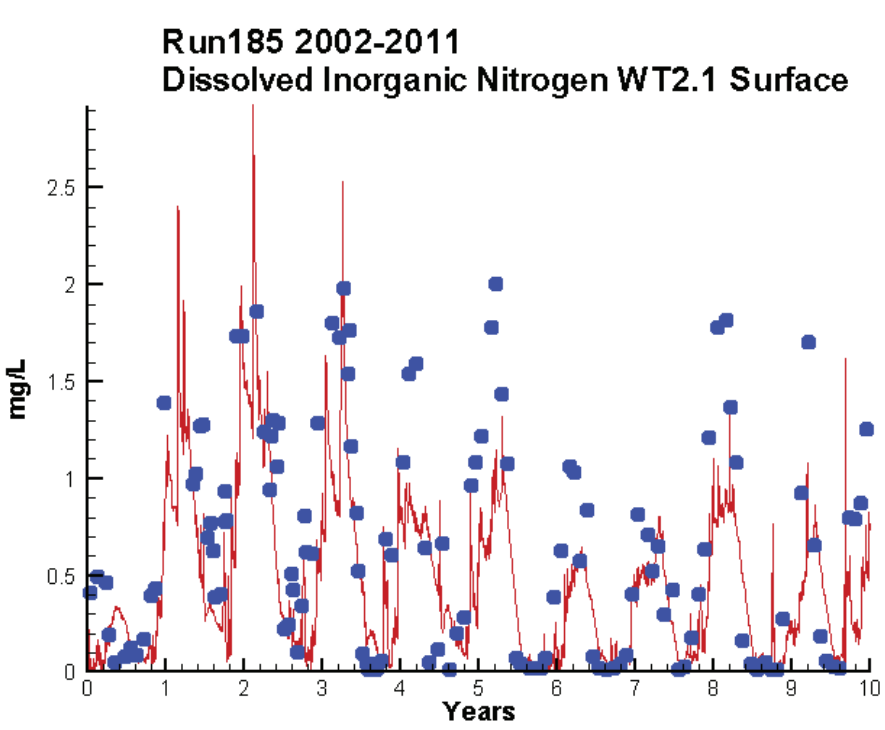


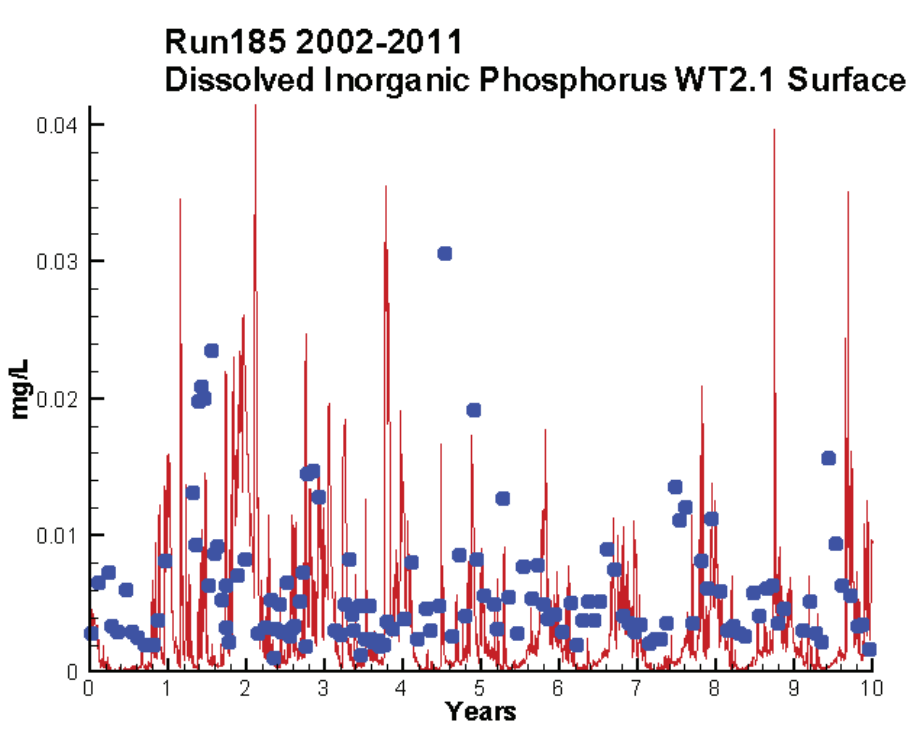
	Mean Difference	Absolute Mean Difference
KE	-0.0746	1.9257
TSS	-3.5132	21.4269

Station WT2.1



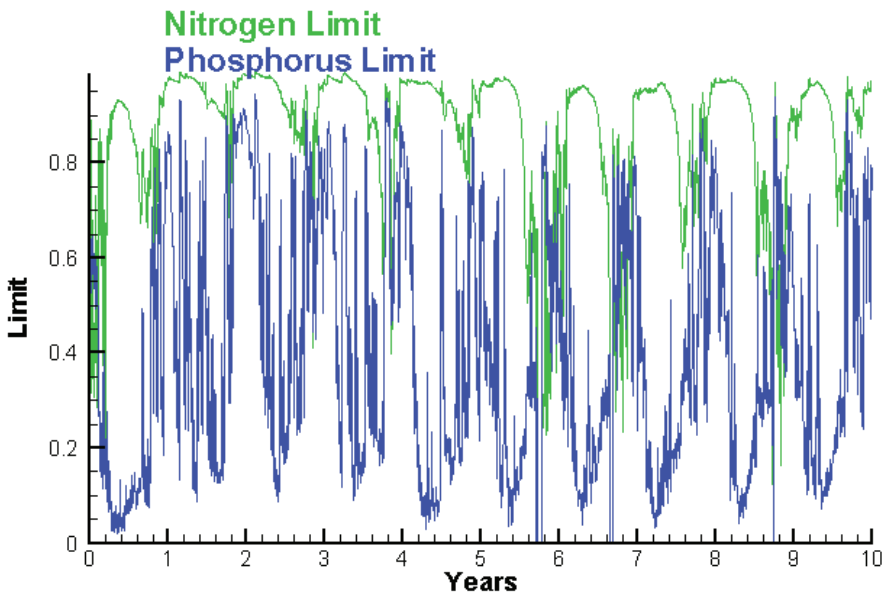




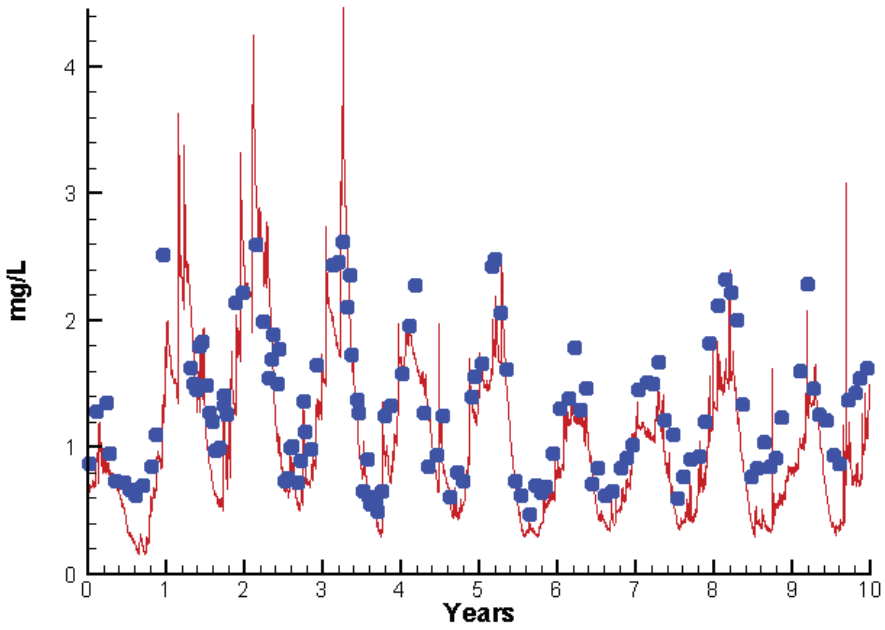


Station WT2.1

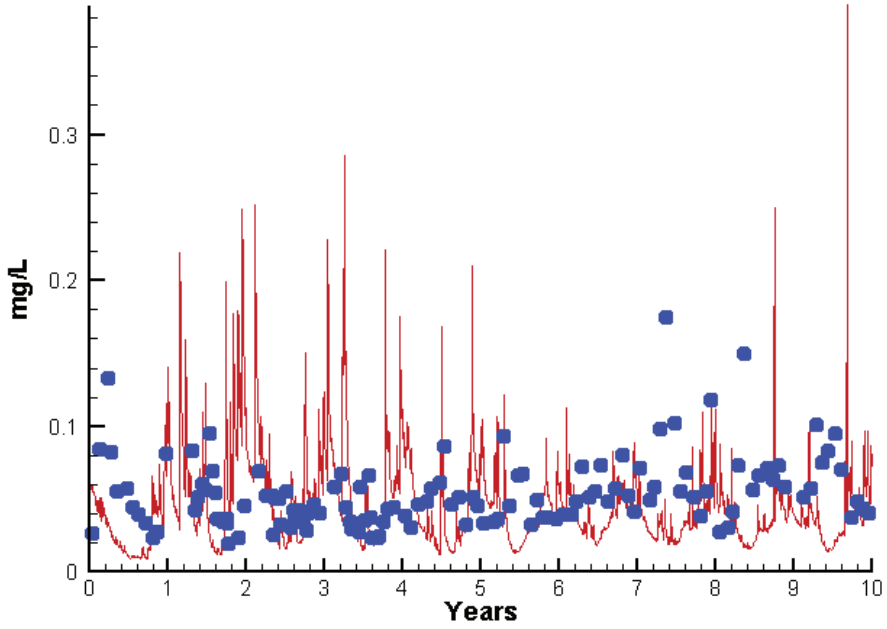
Run185 2002-2011
Algal Limits



Run185 2002-2011
Total Nitrogen WT2.1 Surface

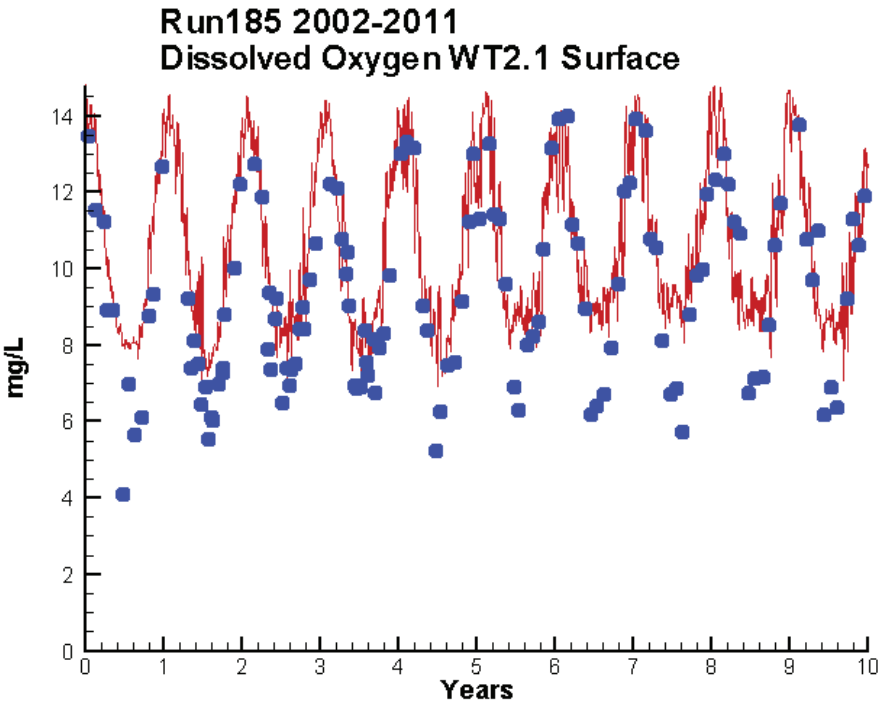


Run185 2002-2011
Total Phosphorus WT2.1 Surface



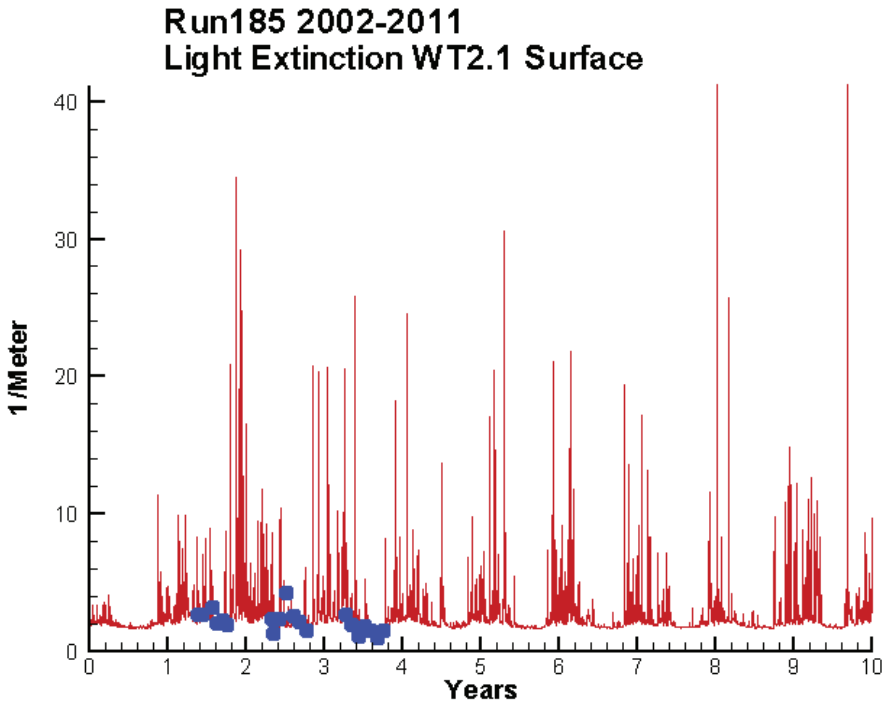
	Mean Difference	Absolute Mean Difference
Chl	-8.5253	10.9572
DIN	-0.2368	0.3260
KE	0.6661	1.1569
DIP	-0.0028	0.0048
TP	-0.0115	0.0300
TN	-0.2819	0.3512

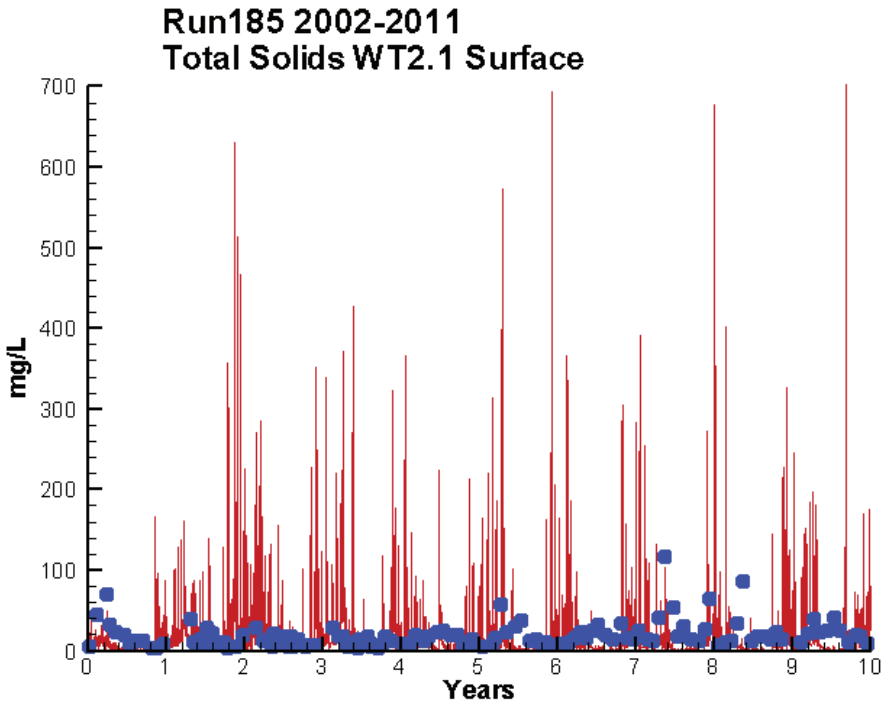
Station WT2.1

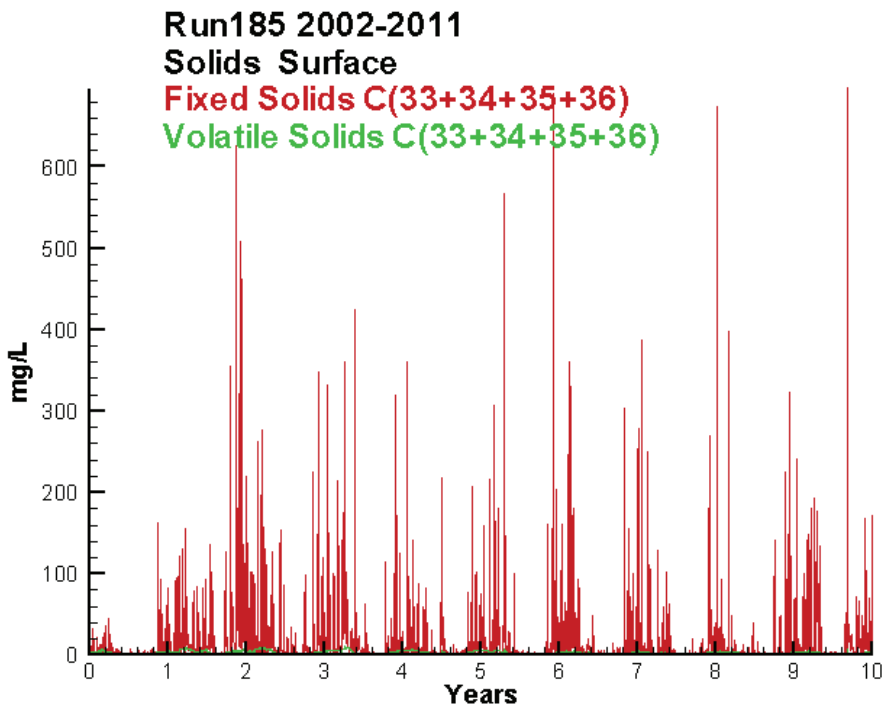


	Mean Difference	Absolute Mean Difference
Top DO	0.9411	1.3067

Station WT2.1



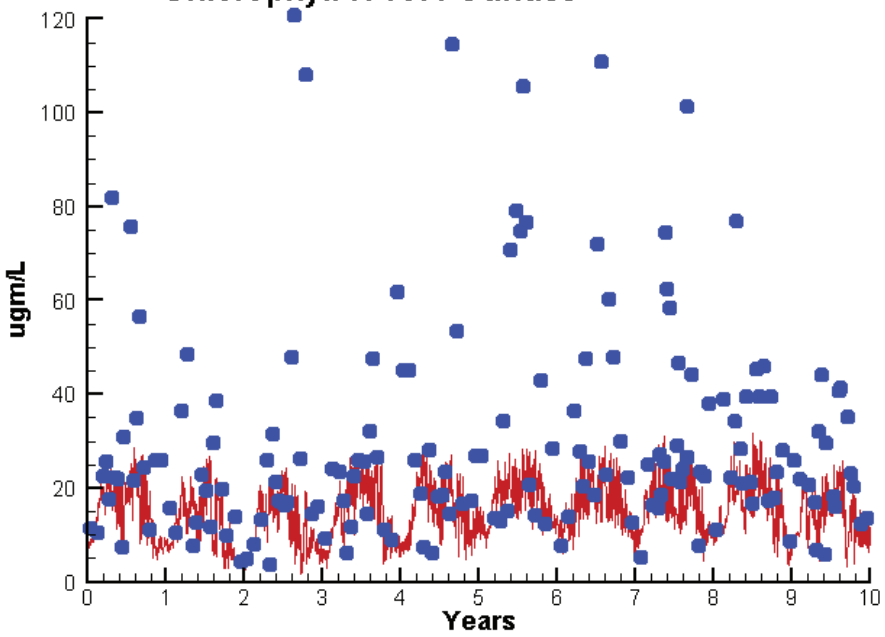




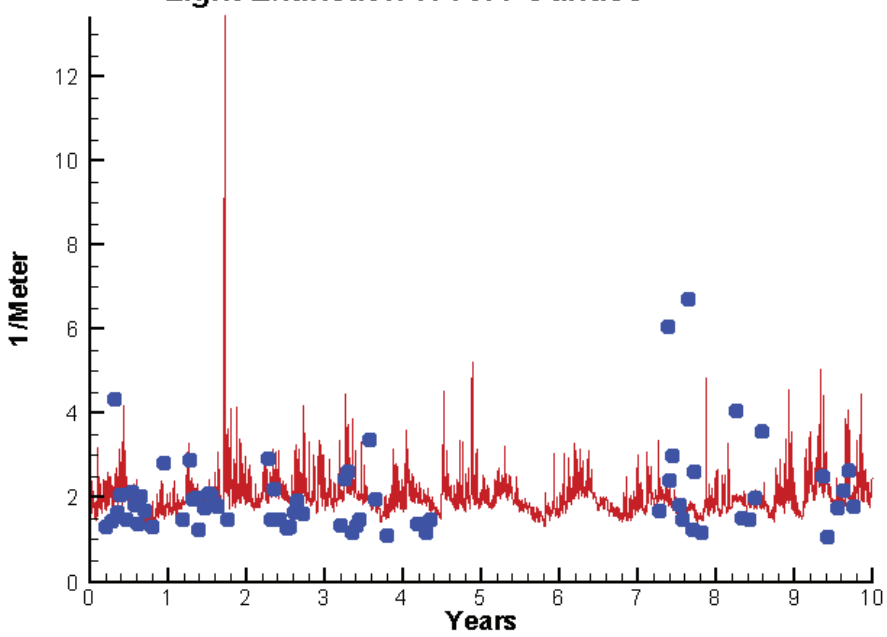
	Mean Difference	Absolute Mean Difference
KE	0.6661	1.1569
TSS	-0.0672	20.8715

Station WT5.1

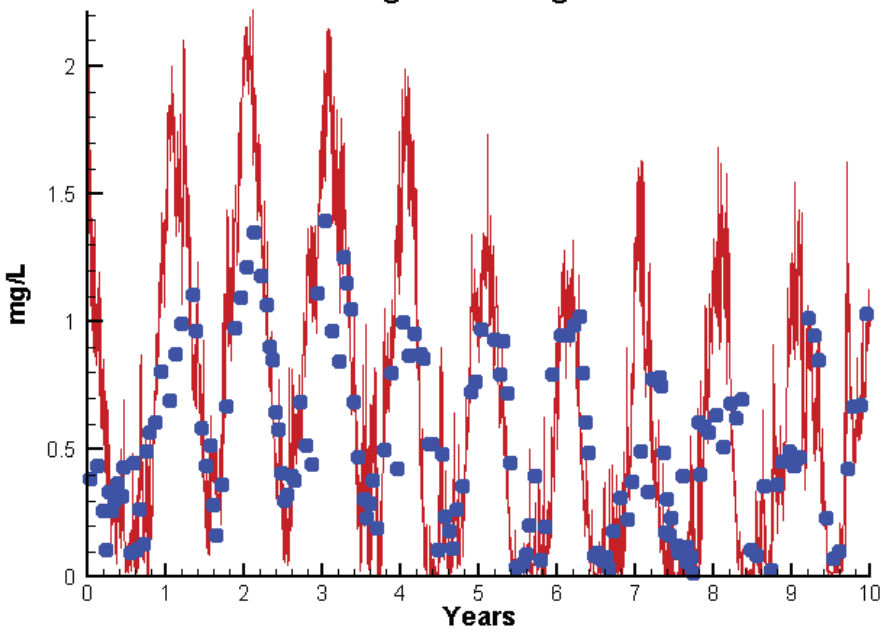
Run185 2002-2011
Chlorophyll WT5.1 Surface



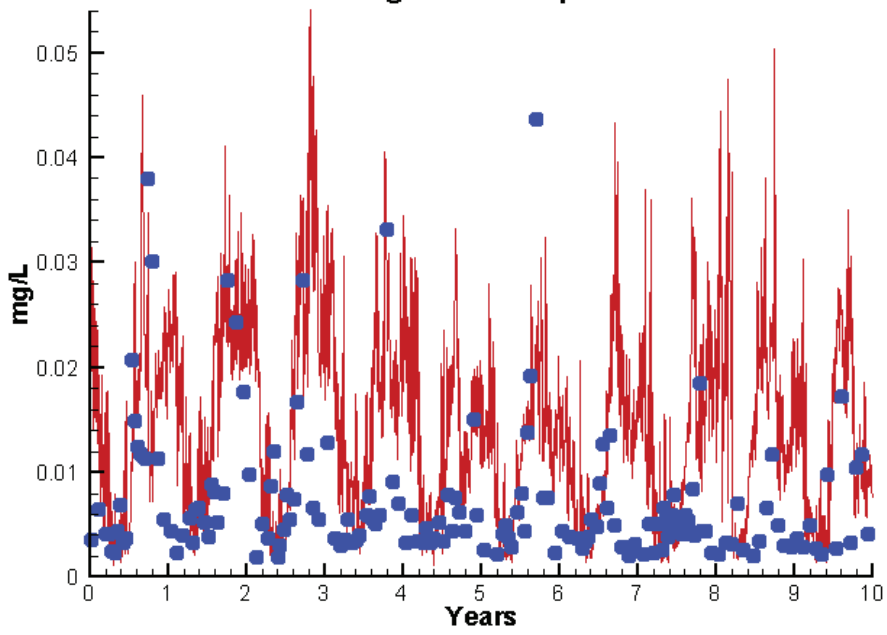
Run185 2002-2011
Light Extinction WT5.1 Surface



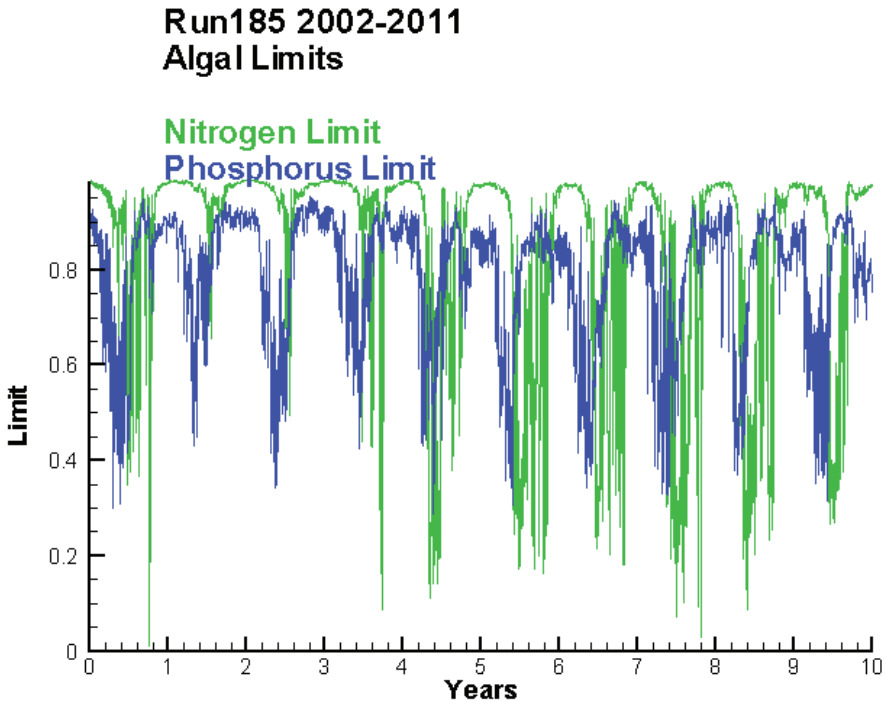
Run185 2002-2011
Dissolved Inorganic Nitrogen WT5.1 Surface

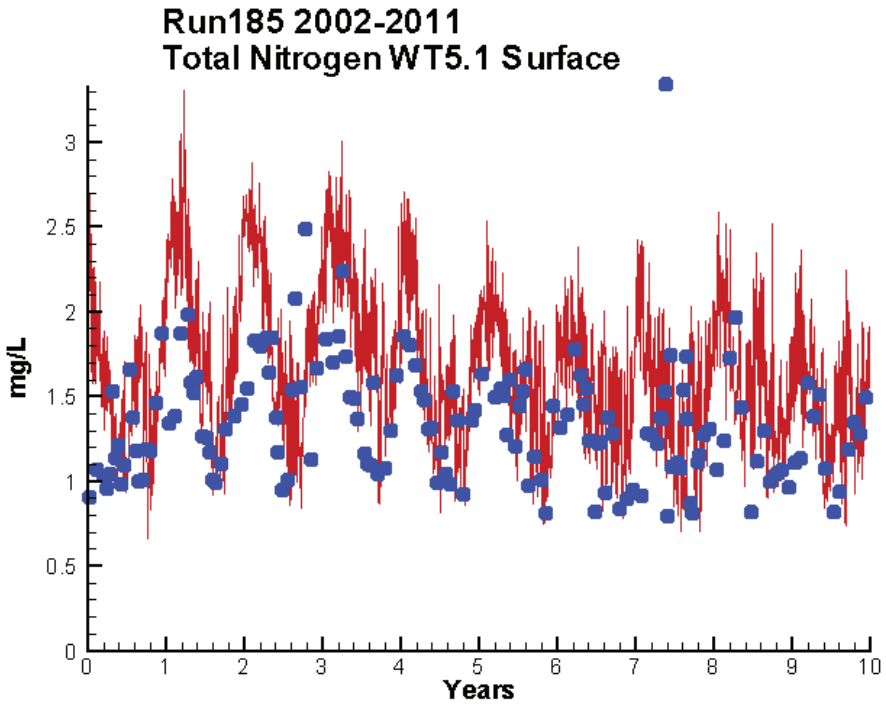


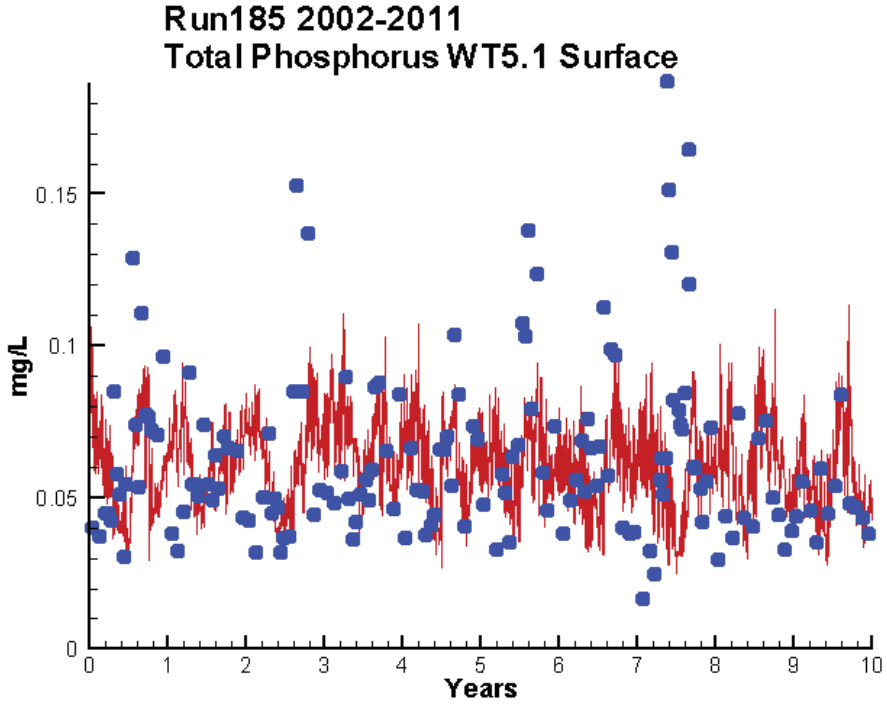
Run185 2002-2011
Dissolved Inorganic Phosphorus WT5.1 Surface



Station WT5.1

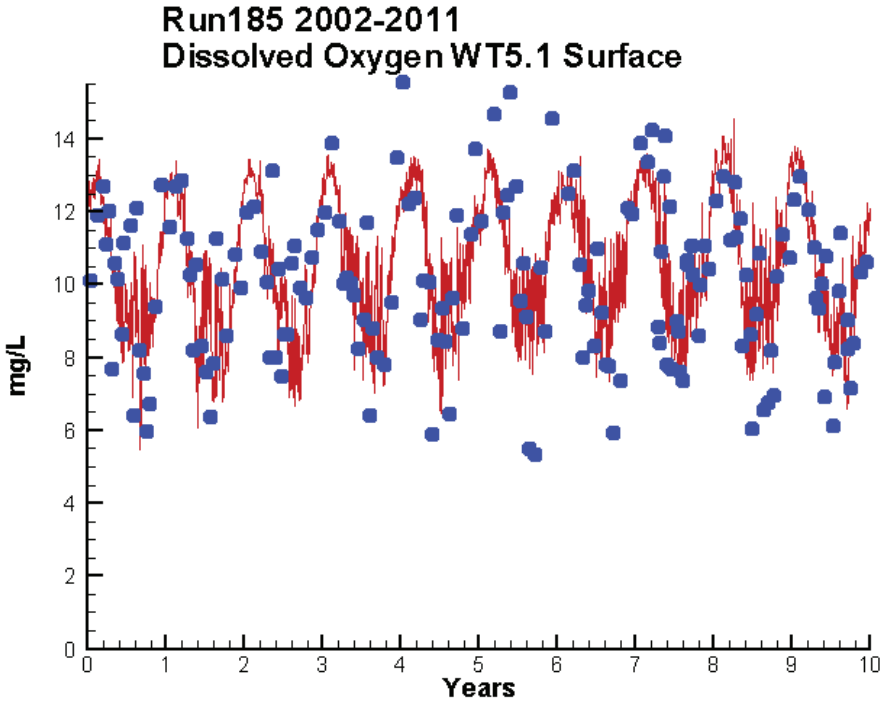


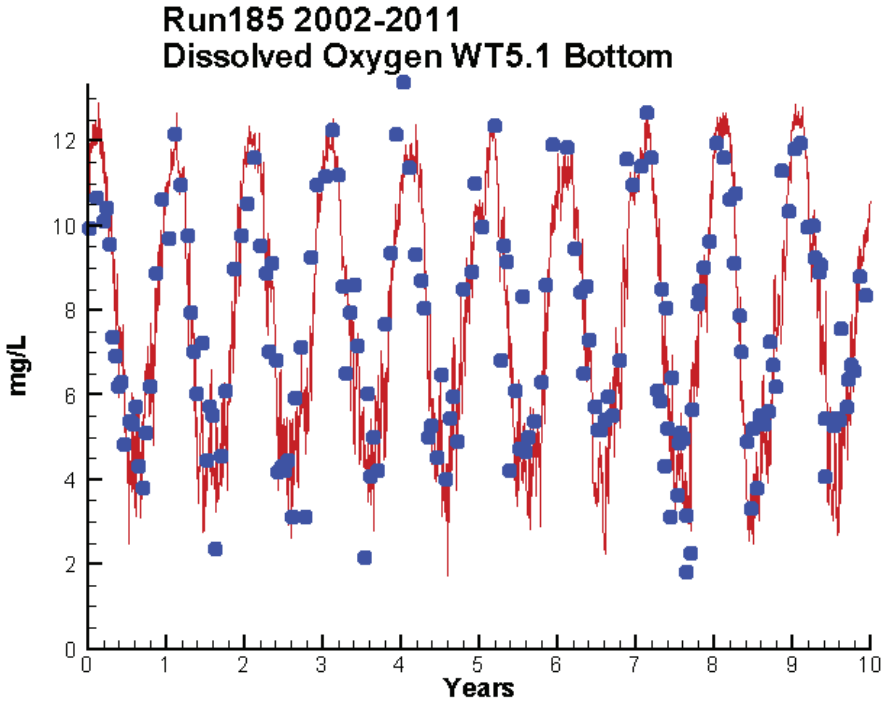


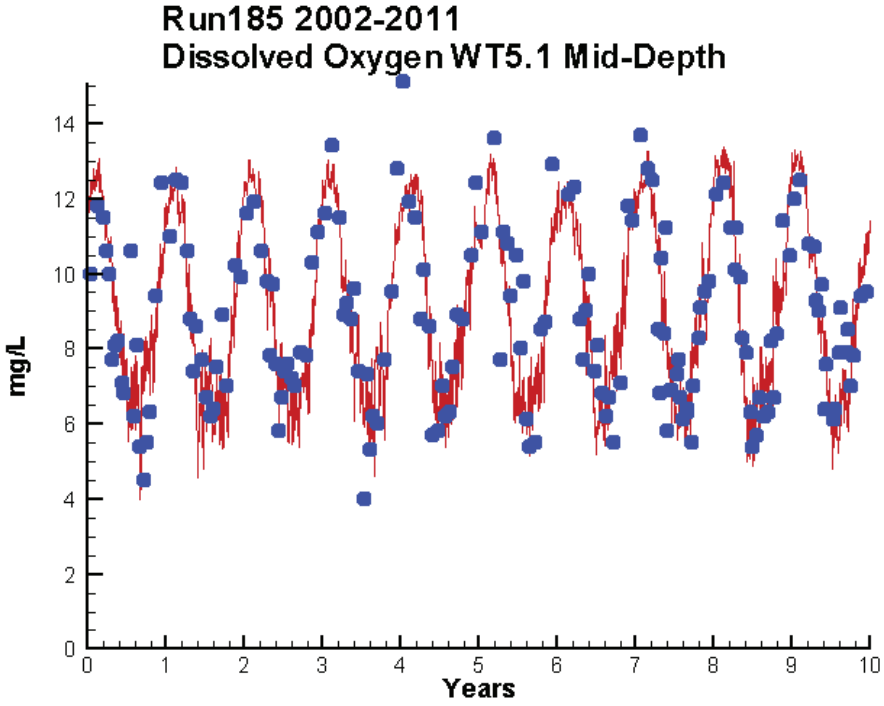


	Mean Difference	Absolute Mean Difference
Chl	-13.8791	17.0761
DIN	0.0429	0.2723
KE	0.0281	0.7673
DIP	0.0064	0.0083
TP	-0.0035	0.0214
TN	0.2797	0.4129

Station WT5.1

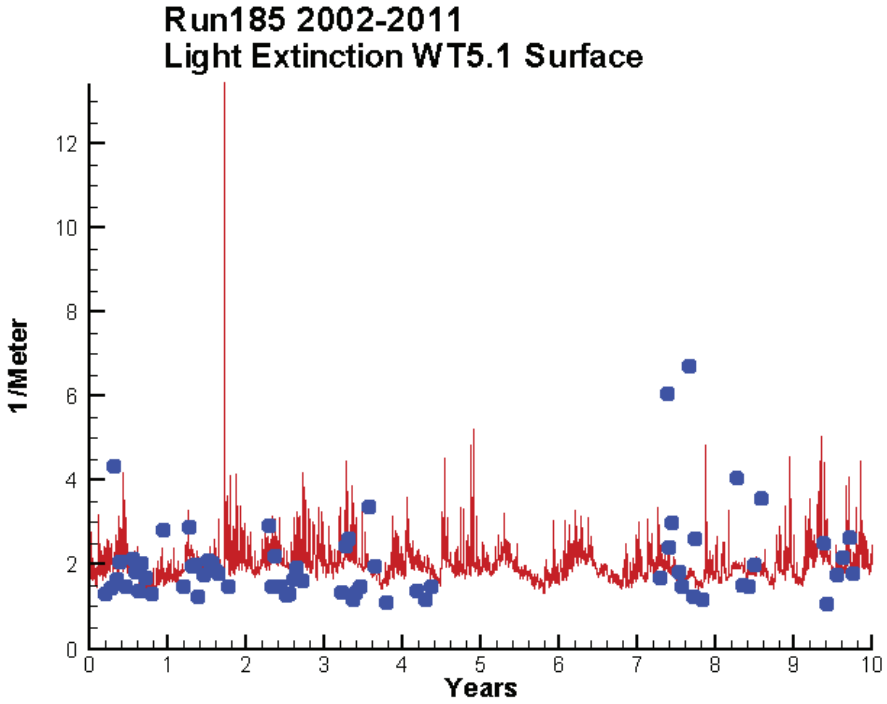


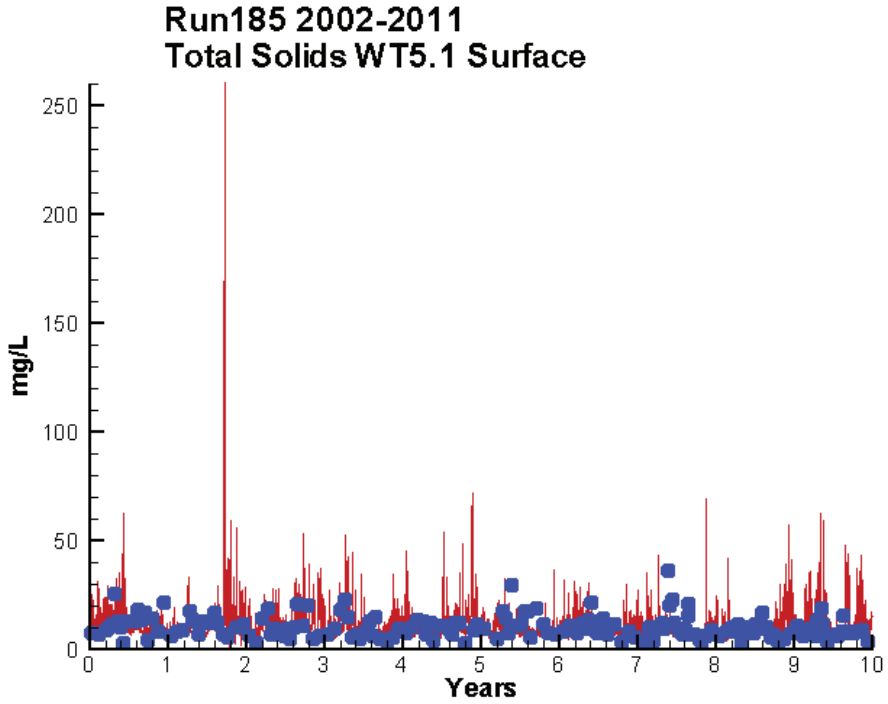


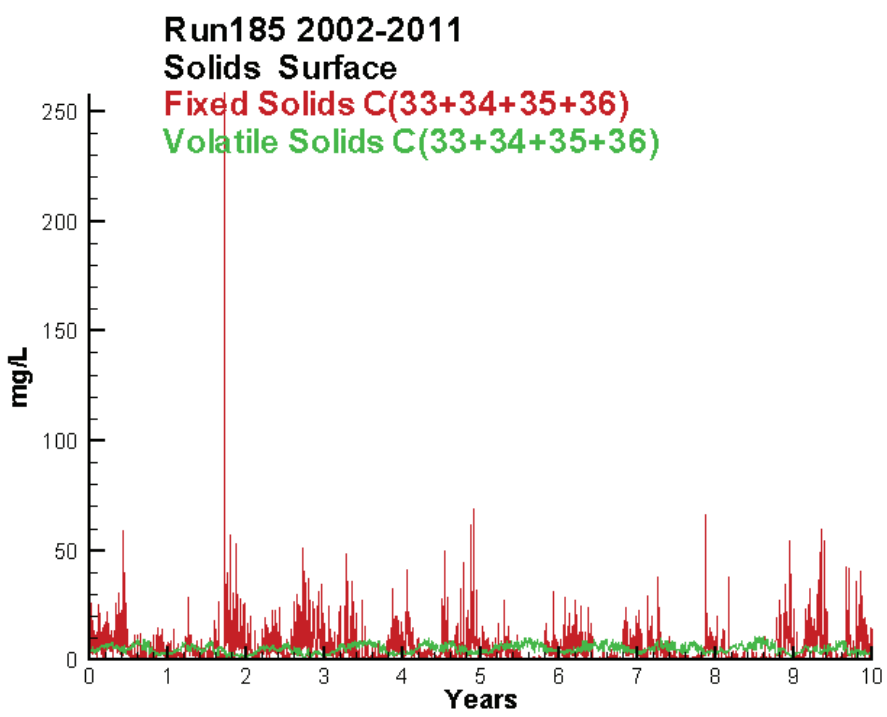


	Mean Difference	Absolute Mean Difference
Top DO	0.2372	1.5480
Mid DO	-0.0301	1.0669
Bot DO	-0.0357	1.0405

Station WT5.1

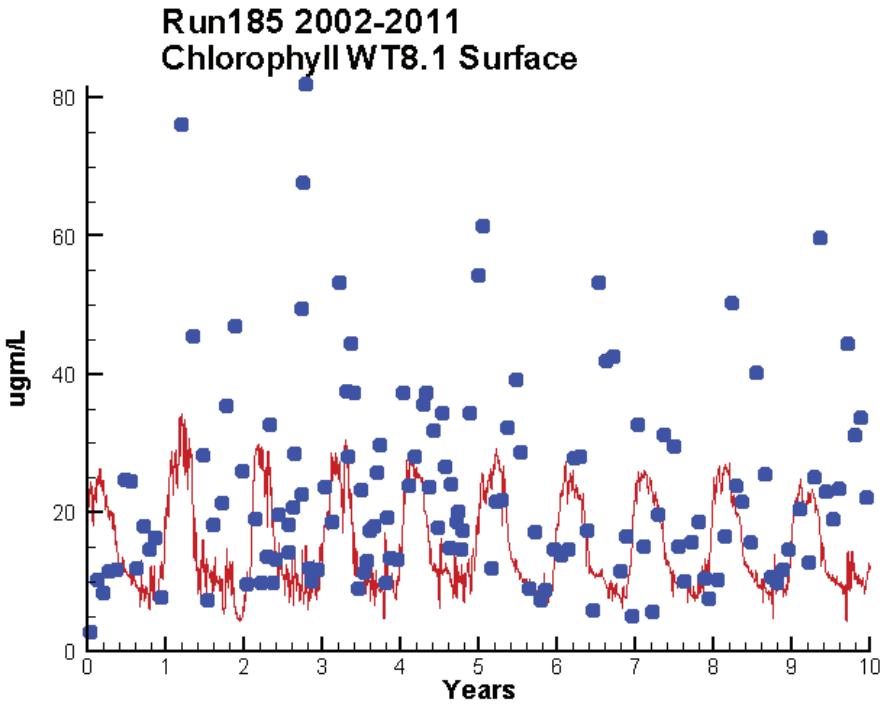


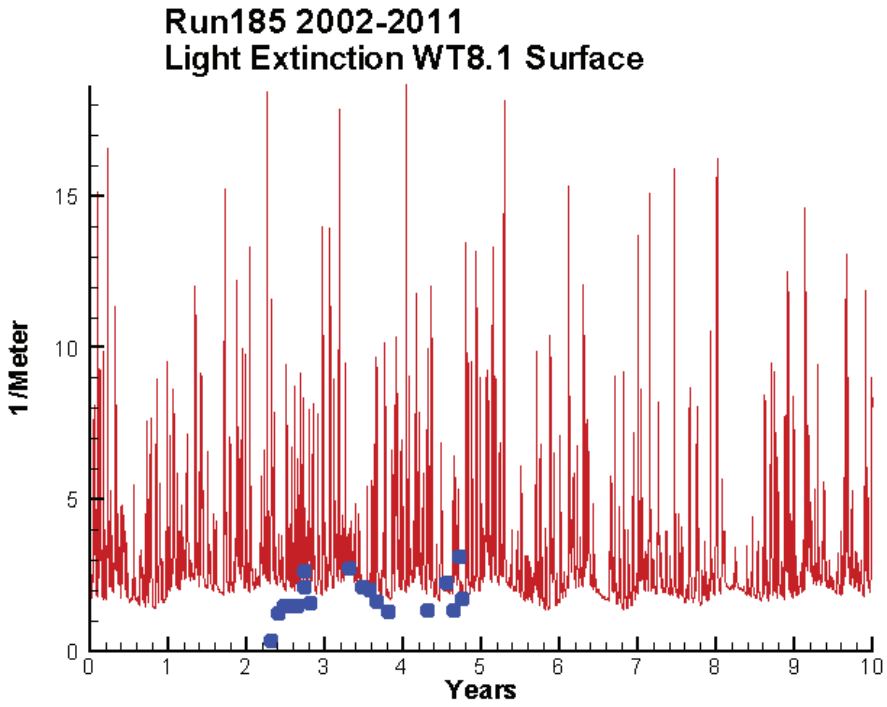


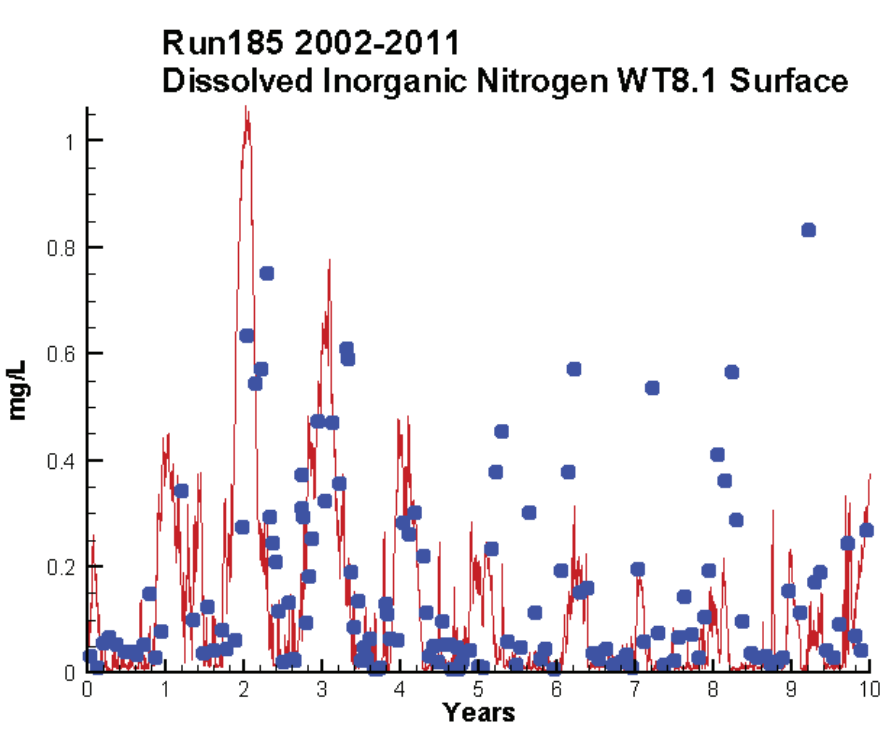


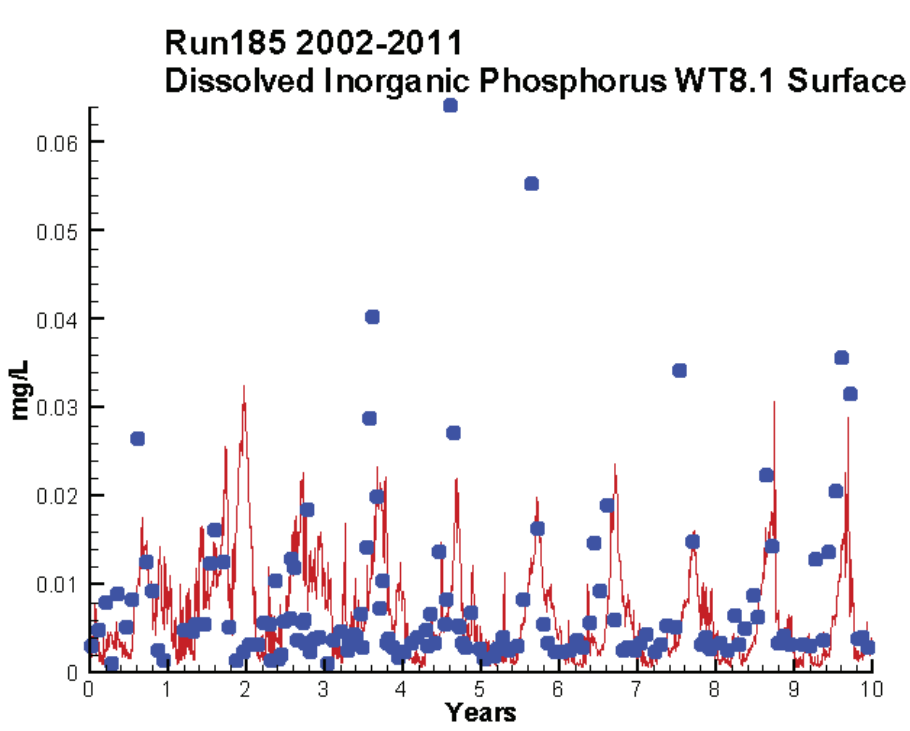
	Mean Difference	Absolute Mean Difference
KE	0.0281	0.7673
TSS	0.9829	5.0410

Station WT8.1

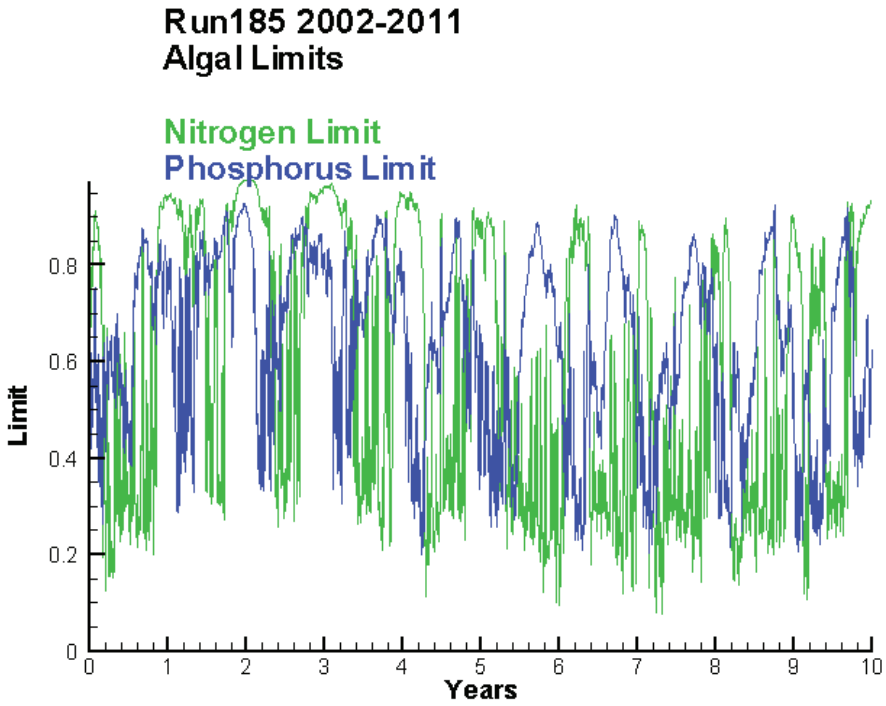


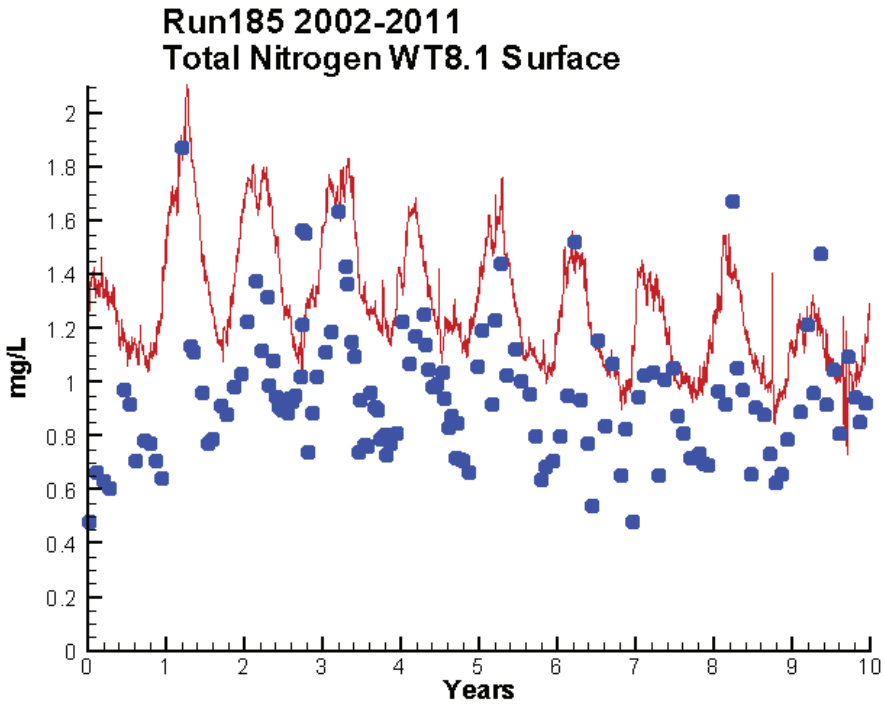


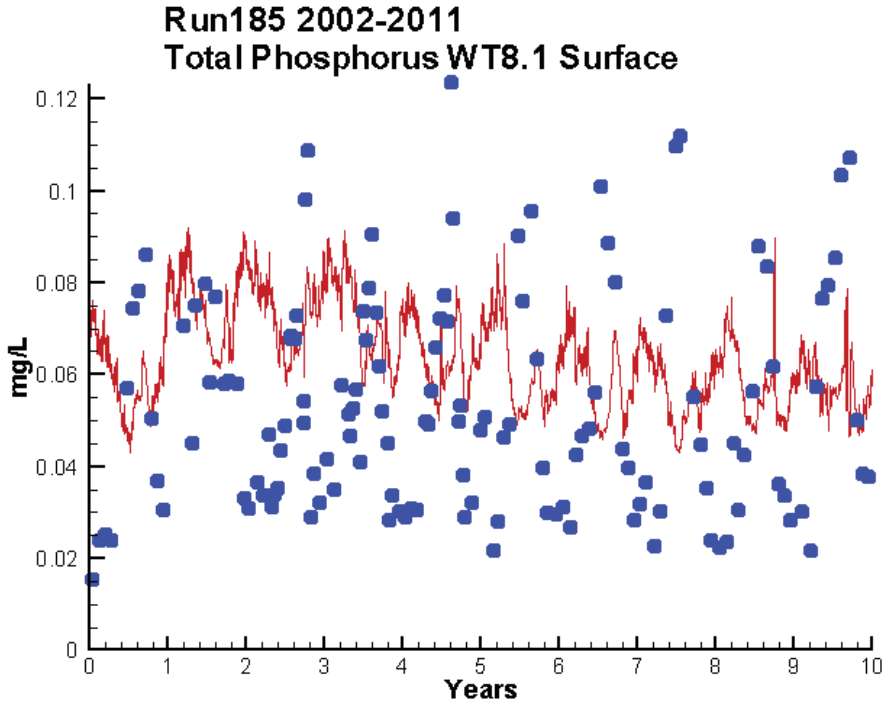




Station WT8.1

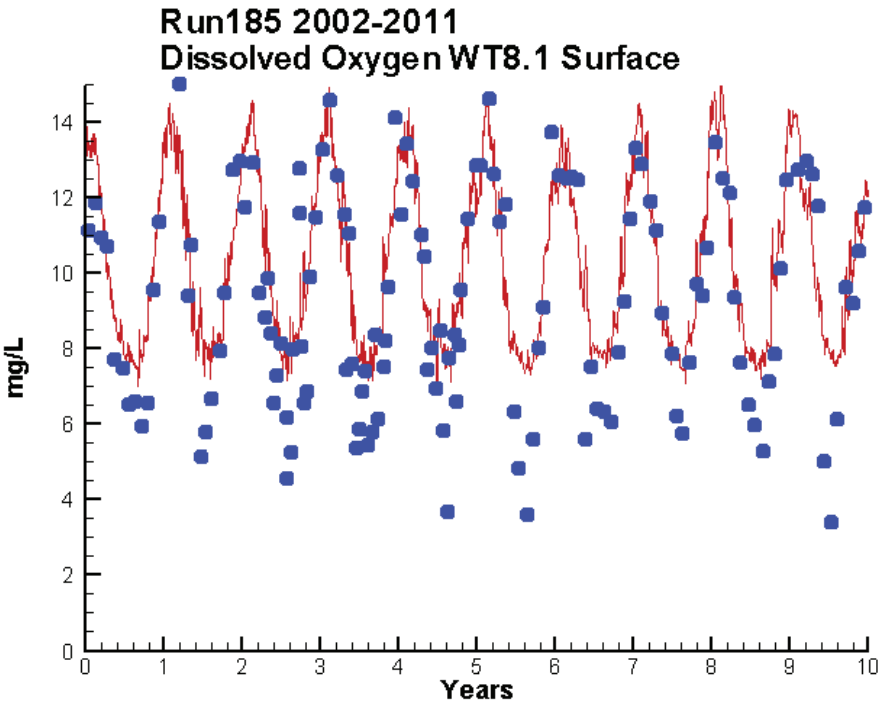






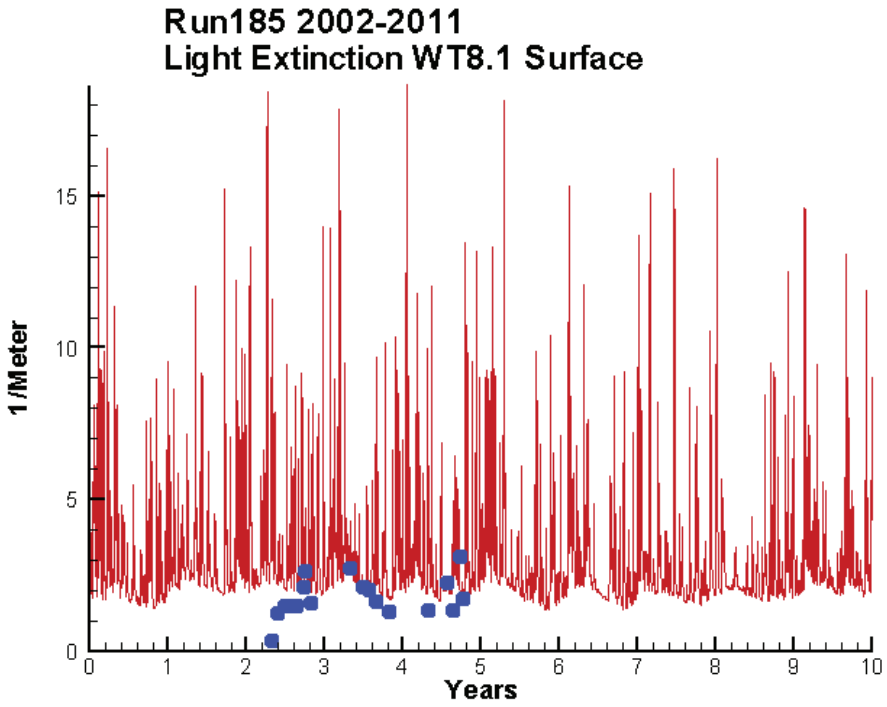
	Mean Difference	Absolute Mean Difference
Chl	-8.7885	12.8334
DIN	-0.0443	0.1193
KE	1.2746	1.4465
DIP	-0.0008	0.0057
TP	0.0107	0.0251
TN	0.3384	0.3633

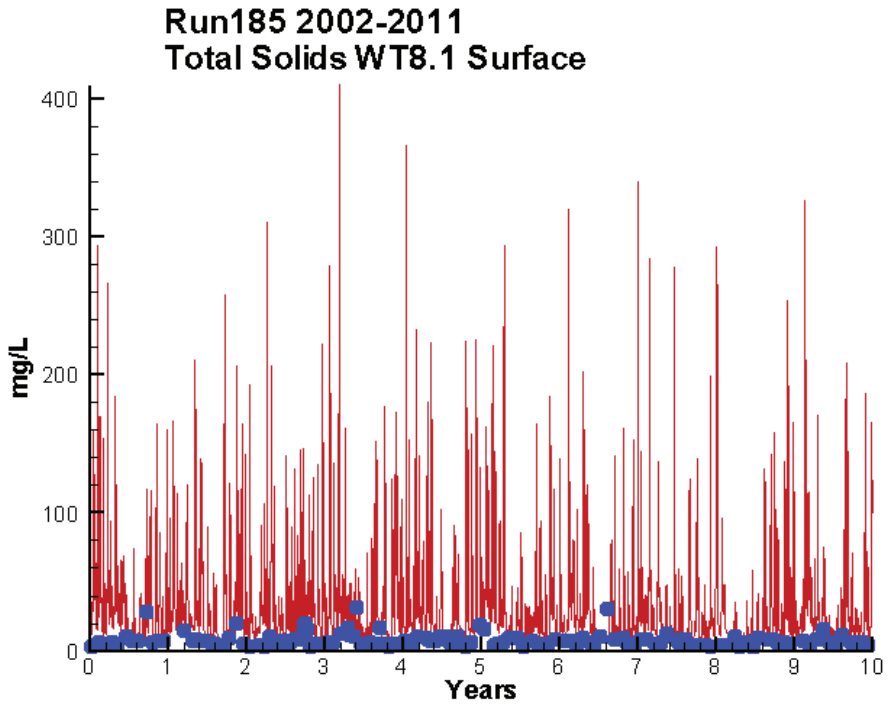
Station WT8.1

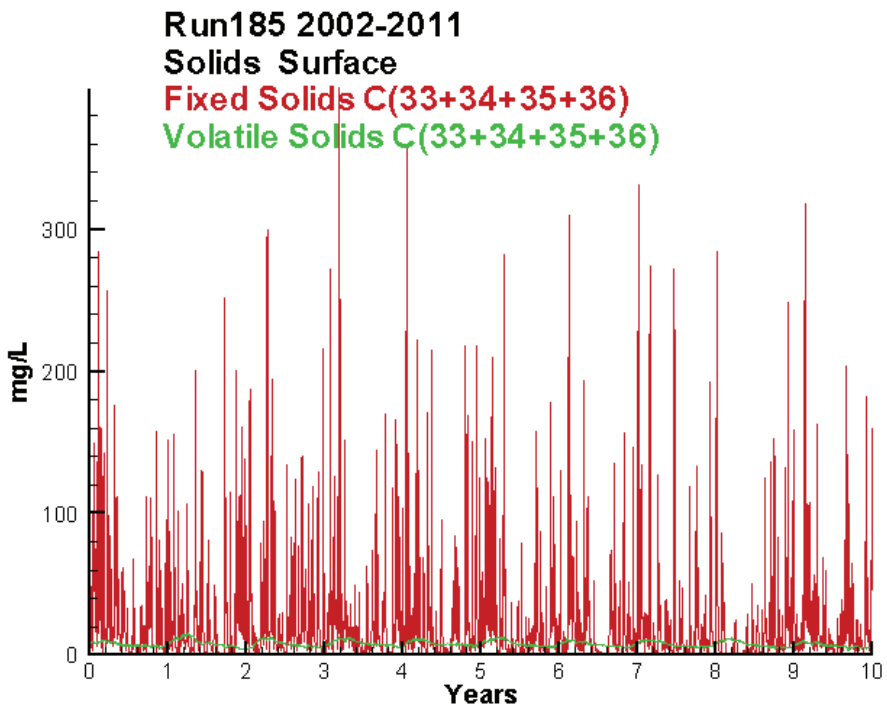


	Mean Difference	Absolute Mean Difference
Top DO	0.8705	1.4387

Station WT8.1







	Mean Difference	Absolute Mean Difference
KE	1.2746	1.4465
TSS	19.0185	19.7479

Appendix C: Longitudinal Comparisons 1991-2000

The spatial distributions of observed and computed properties were compared in a series of plots along the axes of the bay and major tributaries (Figure 1). The calibration period encompassed more than 100 cruises. Reducing this number of surveys into a manageable volume of comparisons required selection and aggregation. Three years were selected for comparisons: 1994, 1996, and 1999. The year 1994 was considered a year of average flow in the Susquehanna River, the source of the majority of runoff to the bay. Flows in 1996 were characterized as above-average while 1996 was a year of below-average runoff.

Model results and observations were averaged into four seasons:

Winter - December through February
Spring - March through May
Summer - June through August
Fall - September through November

Conventional arithmetic means were calculated for the observations. Model results were subjected to a process denoted as "cruise averaging." Within each season, model results were considered only during intervals coinciding with sample cruises. Cruise averaging diminished discrepancies between model and observations attributed to consideration of model results for periods when no data was collected. Daily averages of model results were computed within the model code. Cruise averaging was completed in a postprocessor. Arithmetic averages of modeled substance were computed during cruise periods except for light attenuation and total suspended solids. The variance of the computed values skewed arithmetic means to unrepresentative high values. For these two components, log averages were calculated. The postprocessor also extracted the maximum and minimum computed daily averages.

The mean and range of the observations, at surface and bottom, were compared to the cruise average and range of daily-average model results. The longitudinal axes largely followed the maximum depths represented on the model grid. Only stations located exactly on the transect were considered for comparison with the model. Comparisons were made for physical quantities (salinity, temperature, suspended solids, light attenuation), chlorophyll, dissolved oxygen, and multiple forms of carbon, nitrogen, and phosphorus.

We concentrate here on the components which correspond closely to chlorophyll, clarity, and dissolved oxygen in the critical summer period. Dissolved oxygen is shown at the surface and bottom. Surface samples are from the 1 m depth. Bottom samples are typically 1 m off the bottom and follow local bathymetry. Model values are from surface and bottom cells on the grid. Chlorophyll and light attenuation are presented for the surface only. For all substances, the blue circles and vertical bars indicate mean and range of the observations. The continuous red and green traces represent model mean and range, subject to the selection and averaging process described above.

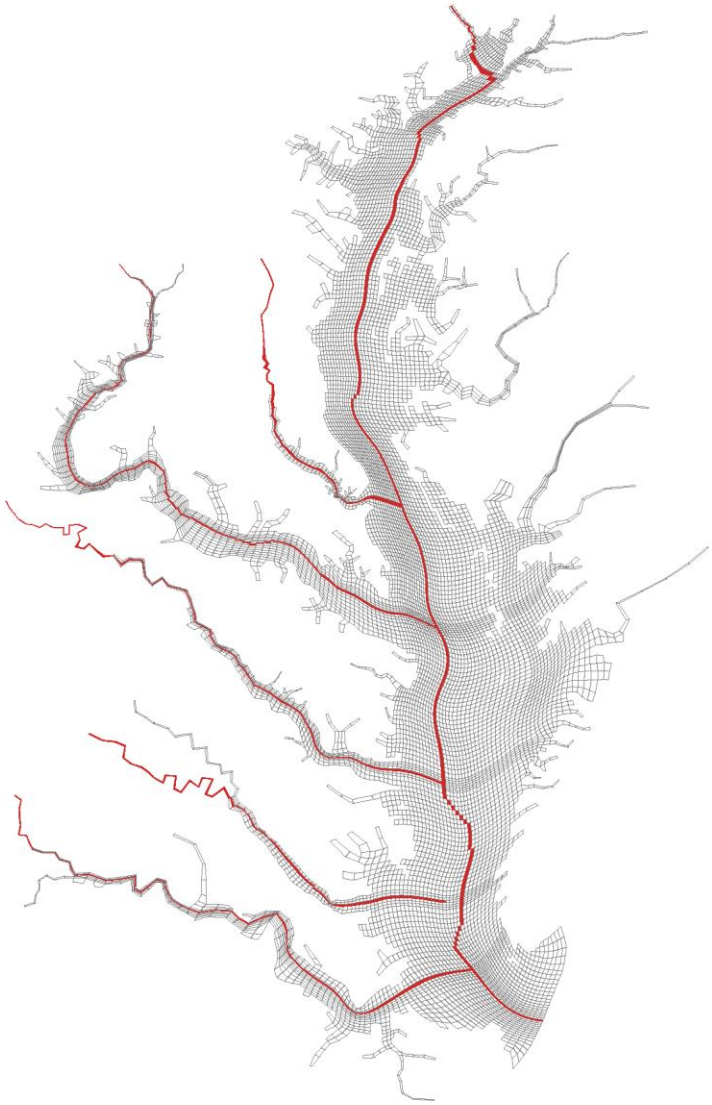
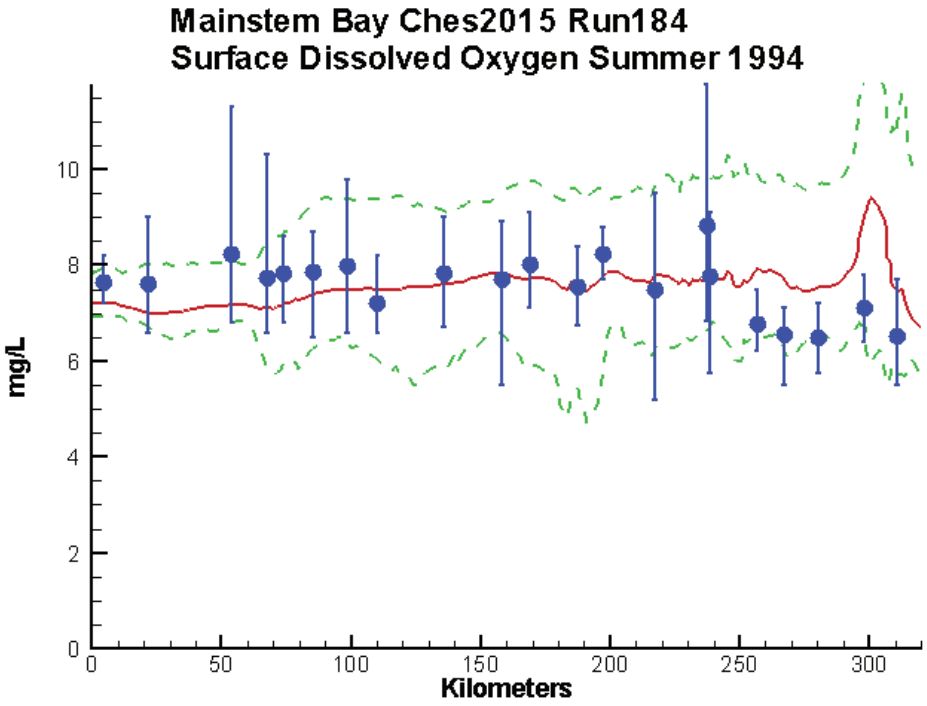
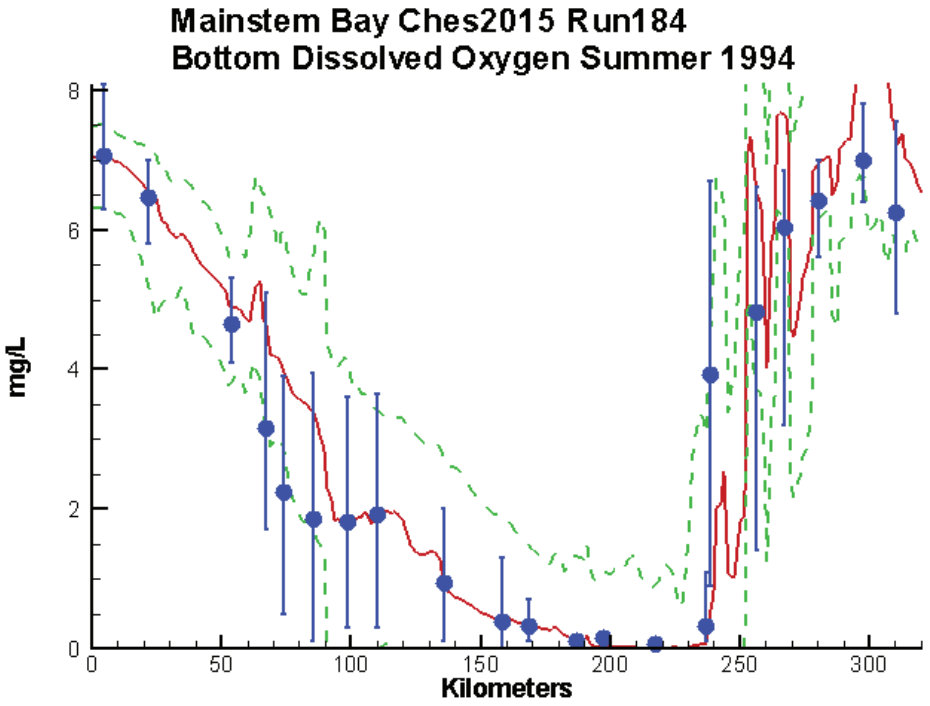
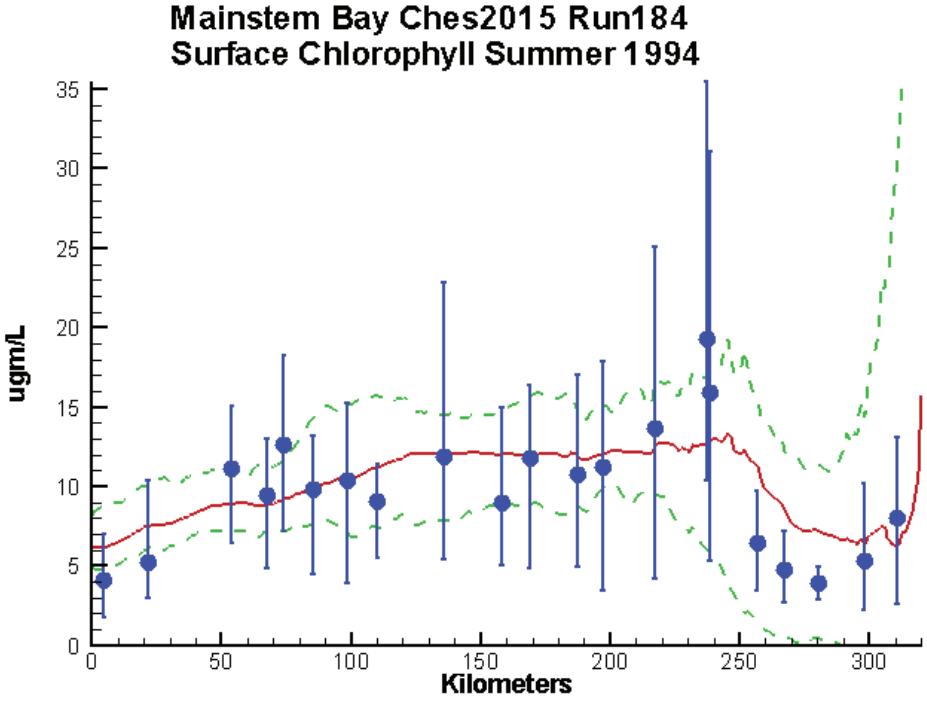


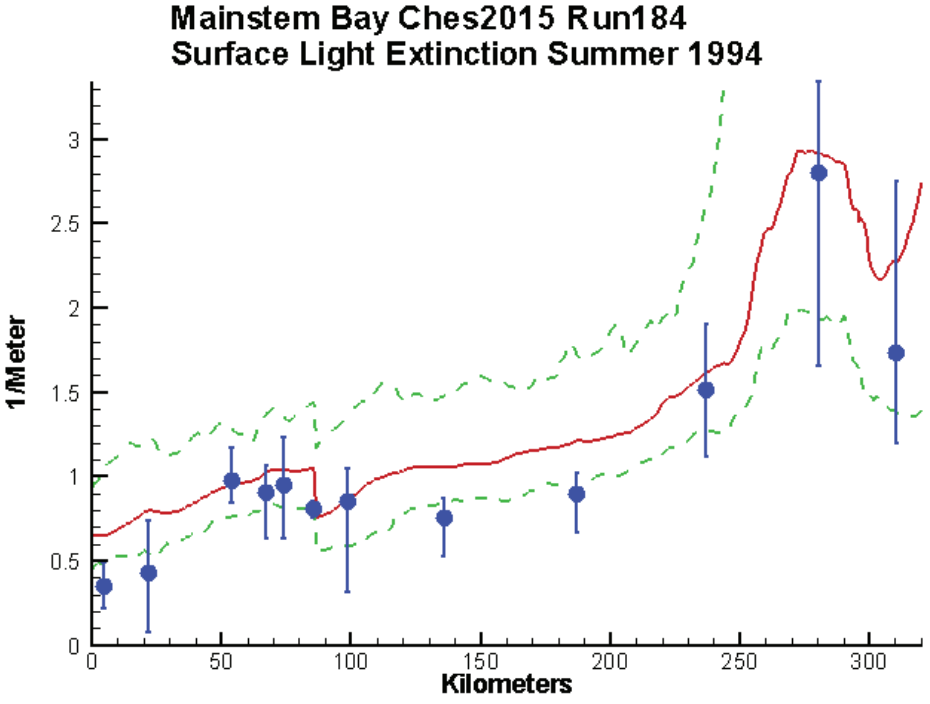
Figure 1. Longitudinal transects in the bay and major tributaries.

Mainstem Bay - Summer - 1994

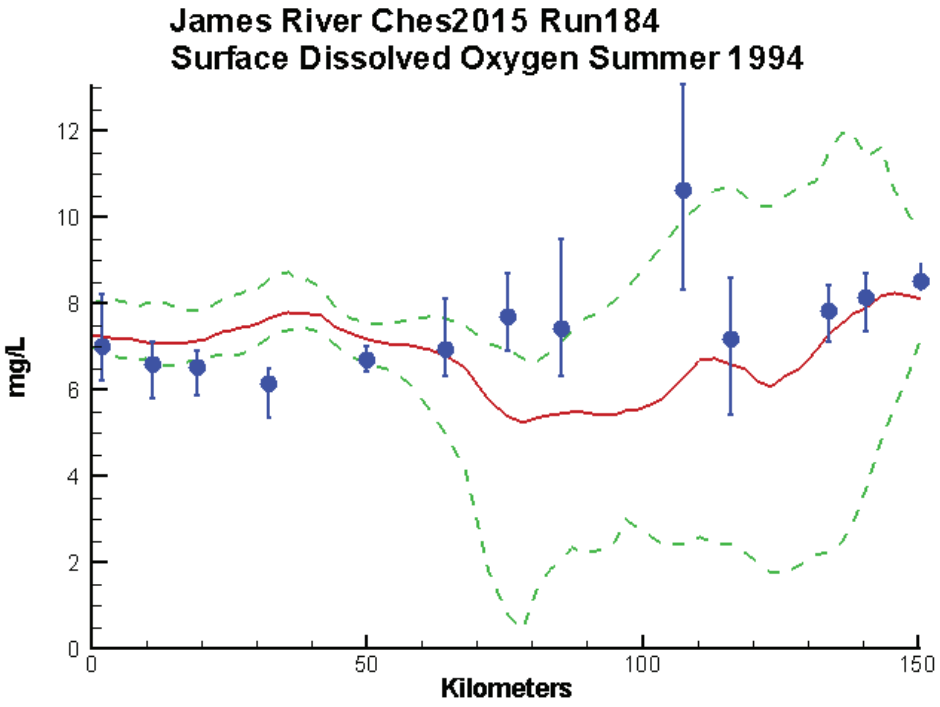


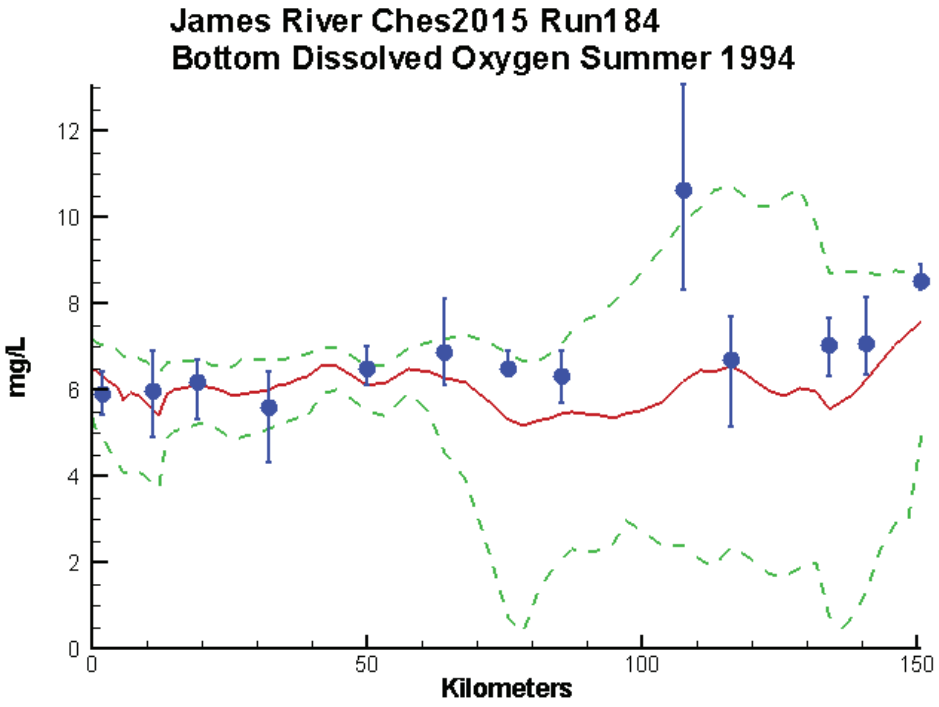


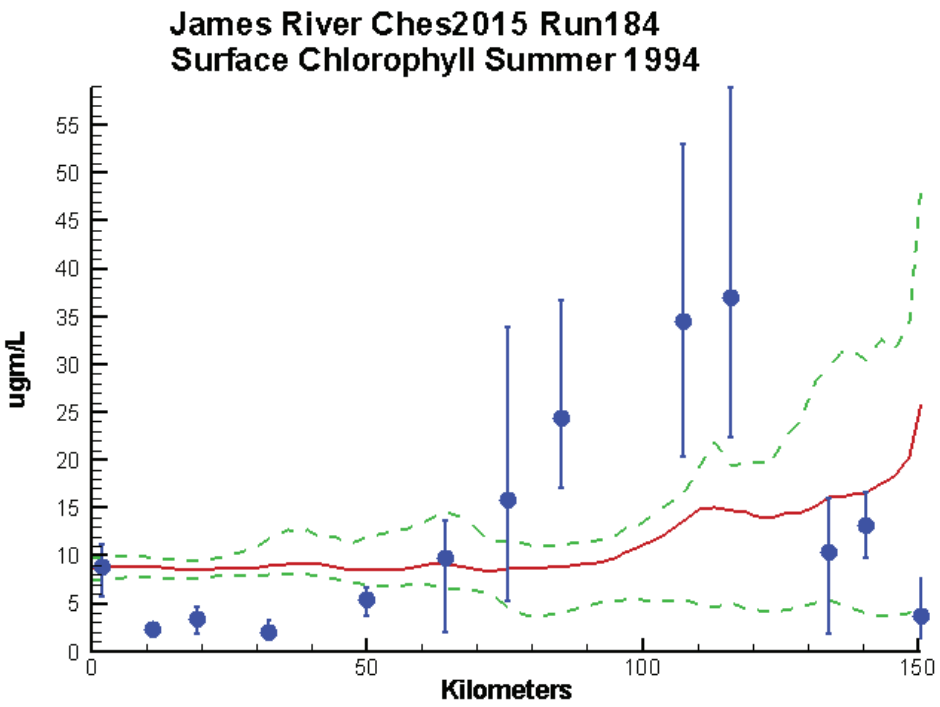


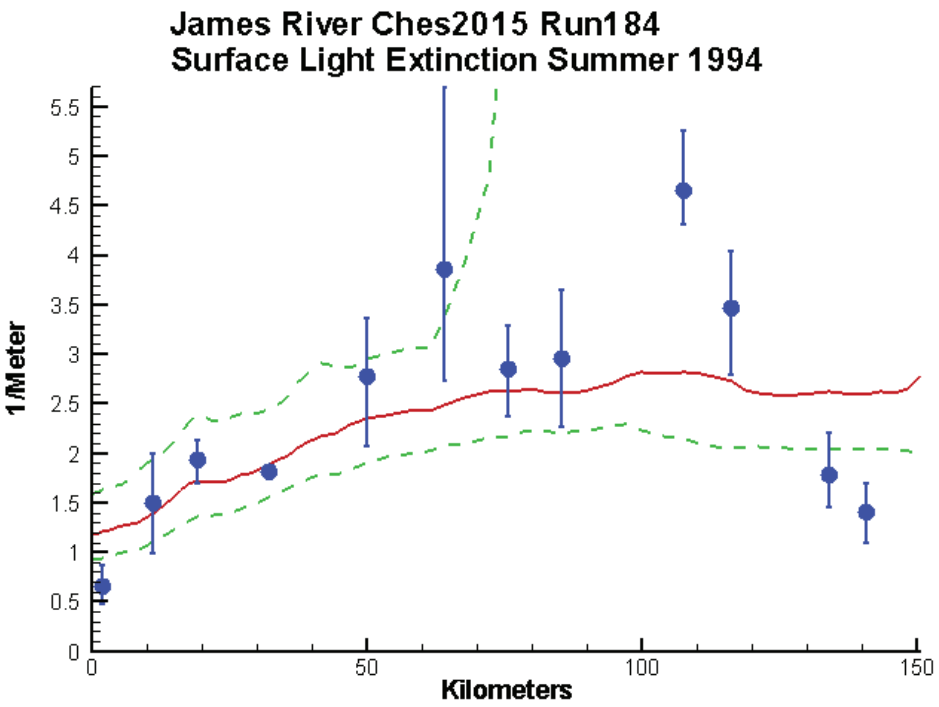


James River - Summer - 1994

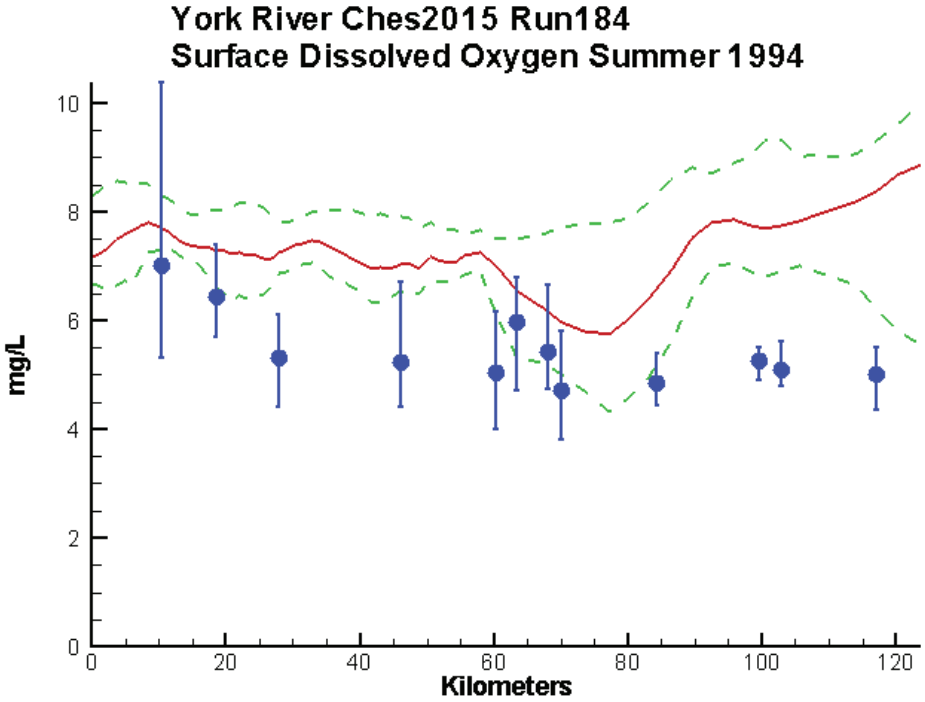


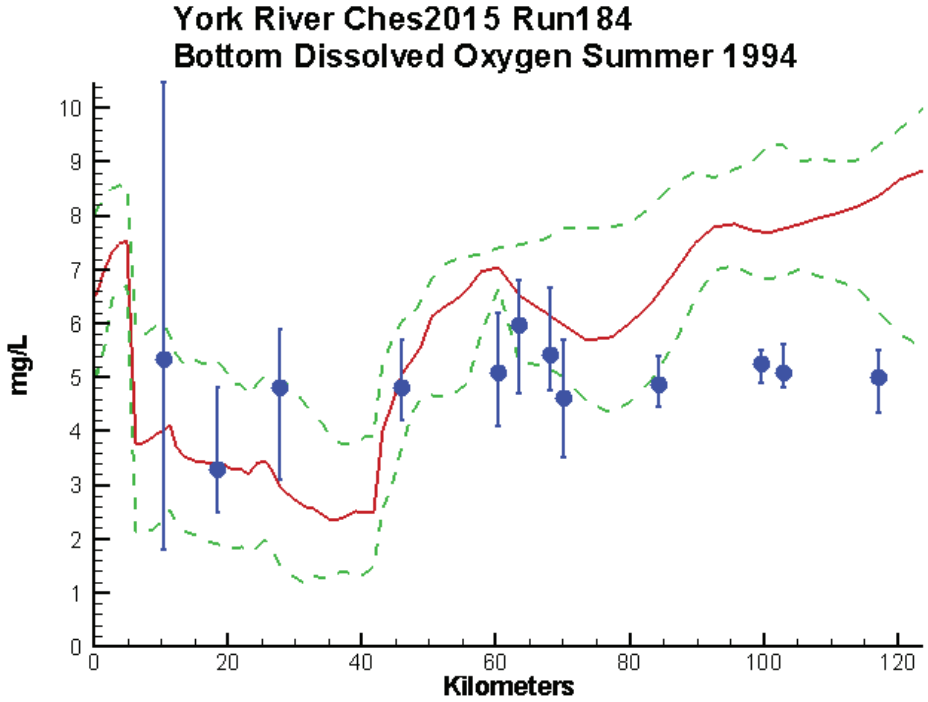


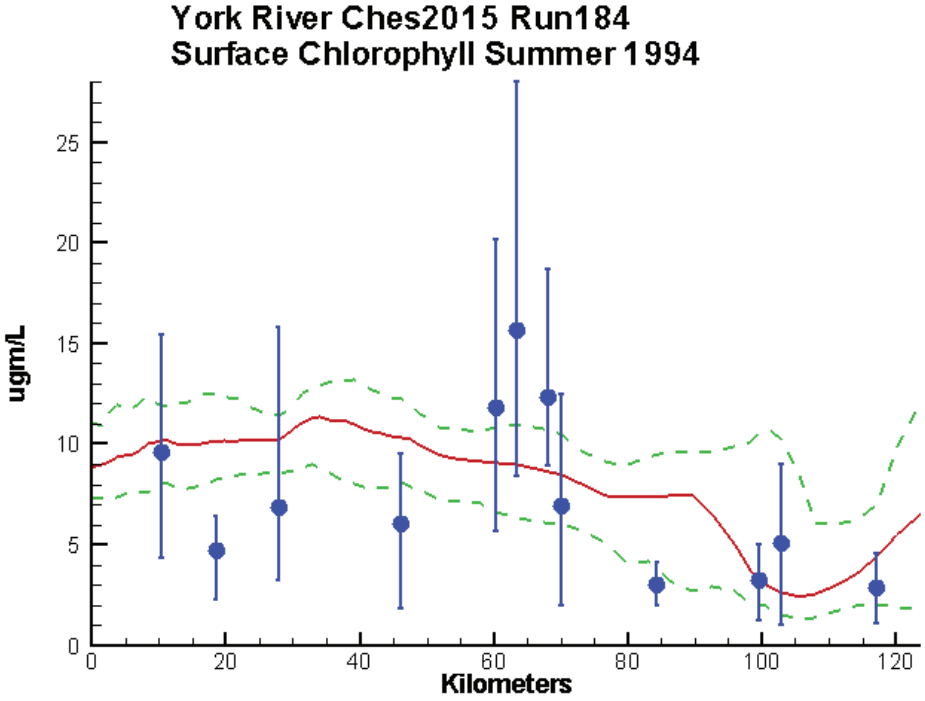


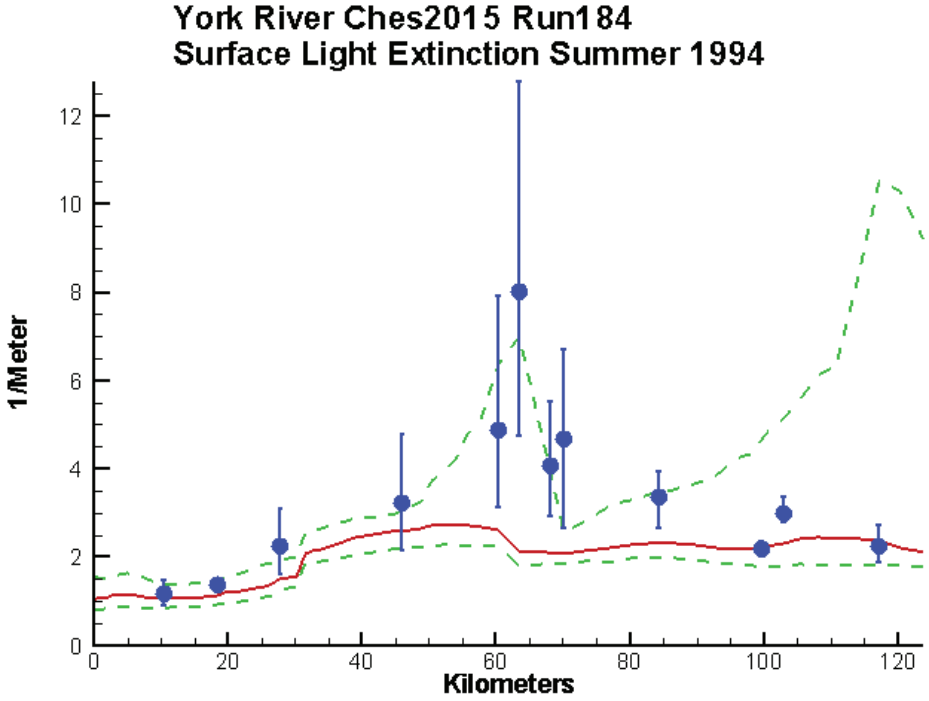


York River - Summer - 1994

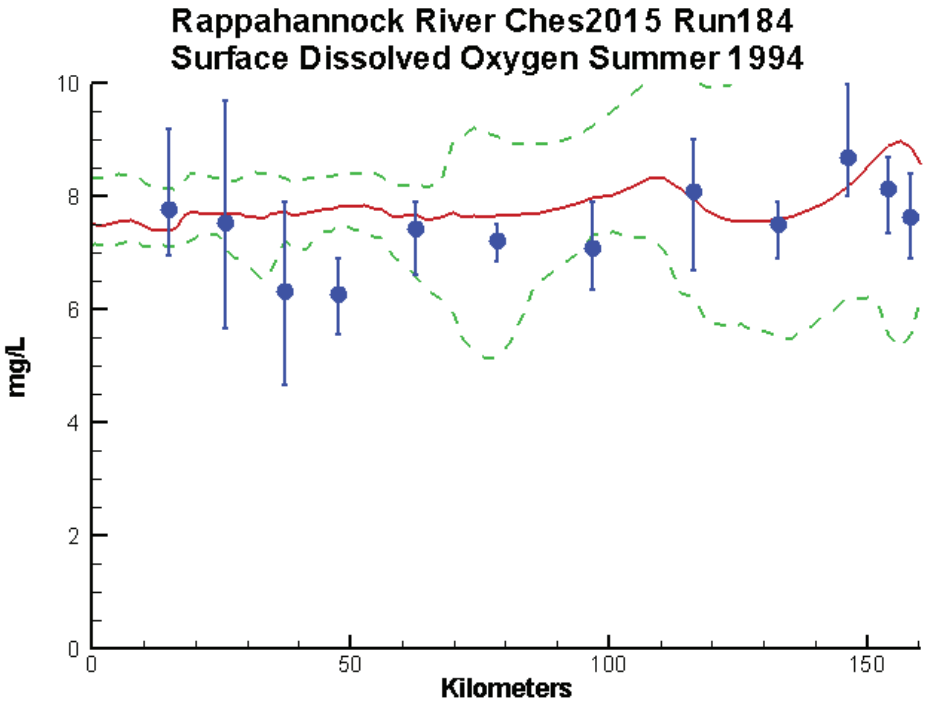


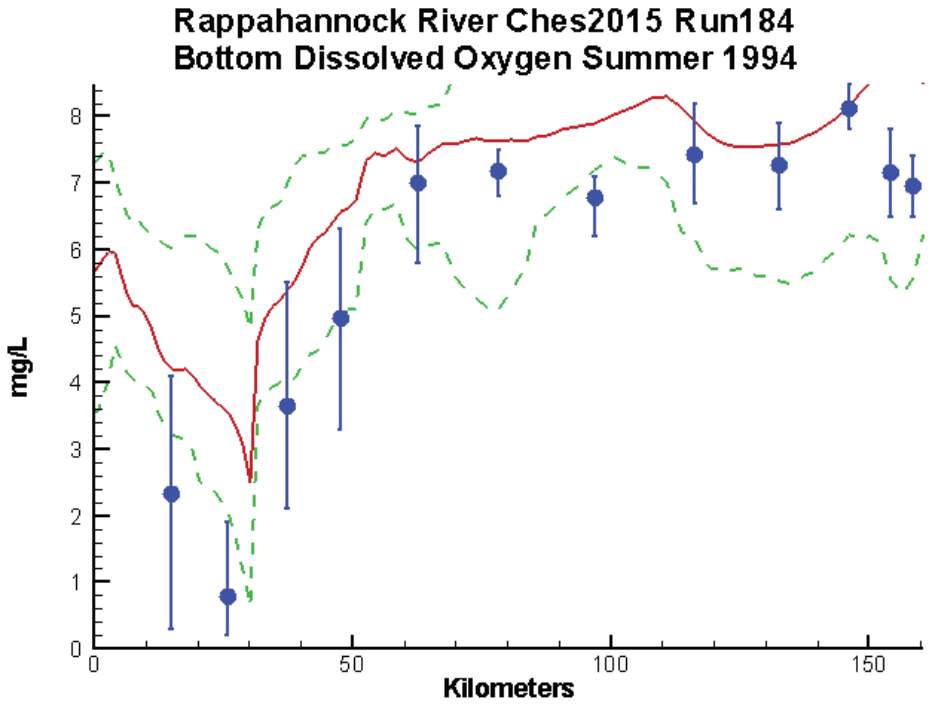


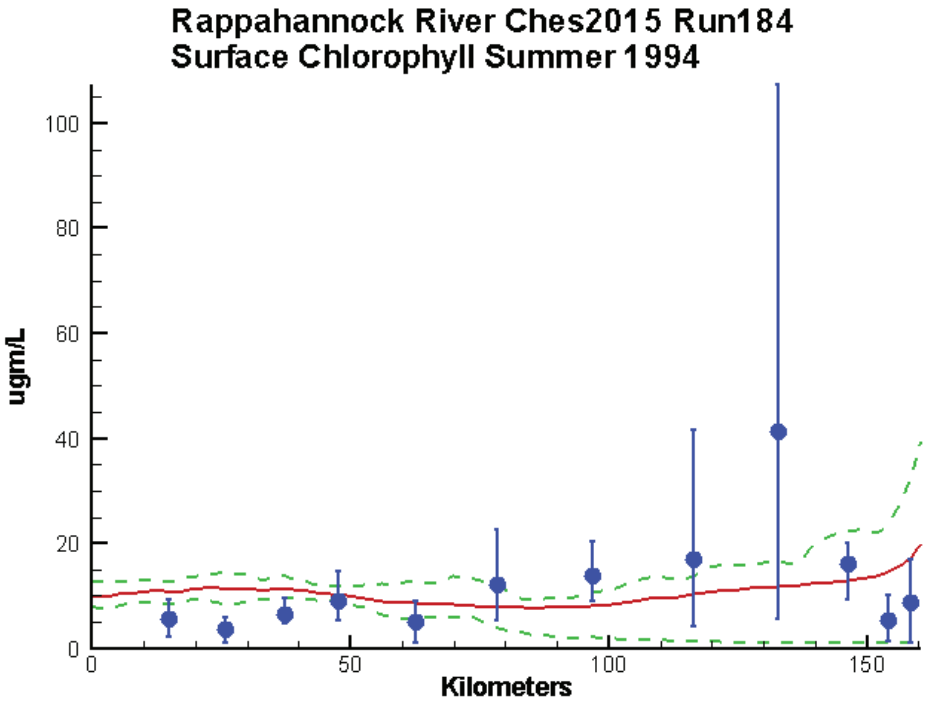


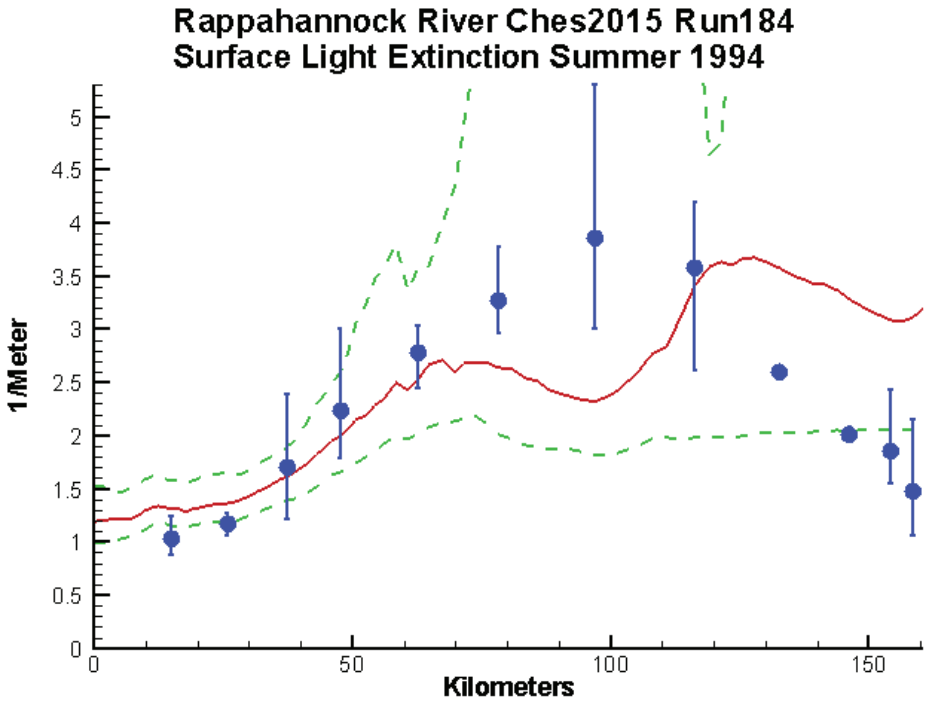


Rappahannock River - Summer - 1994

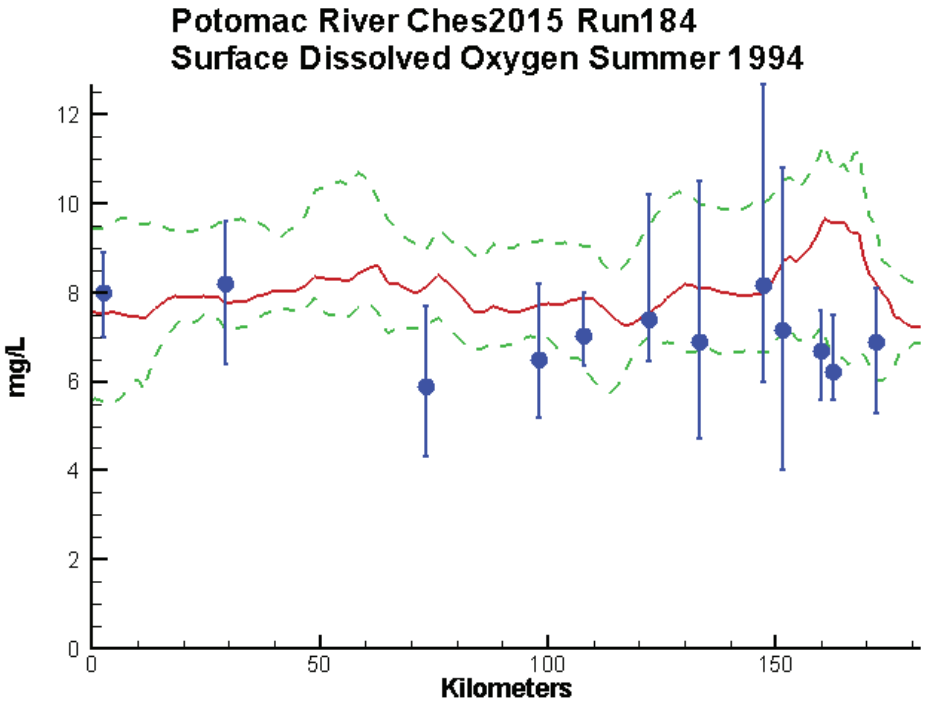


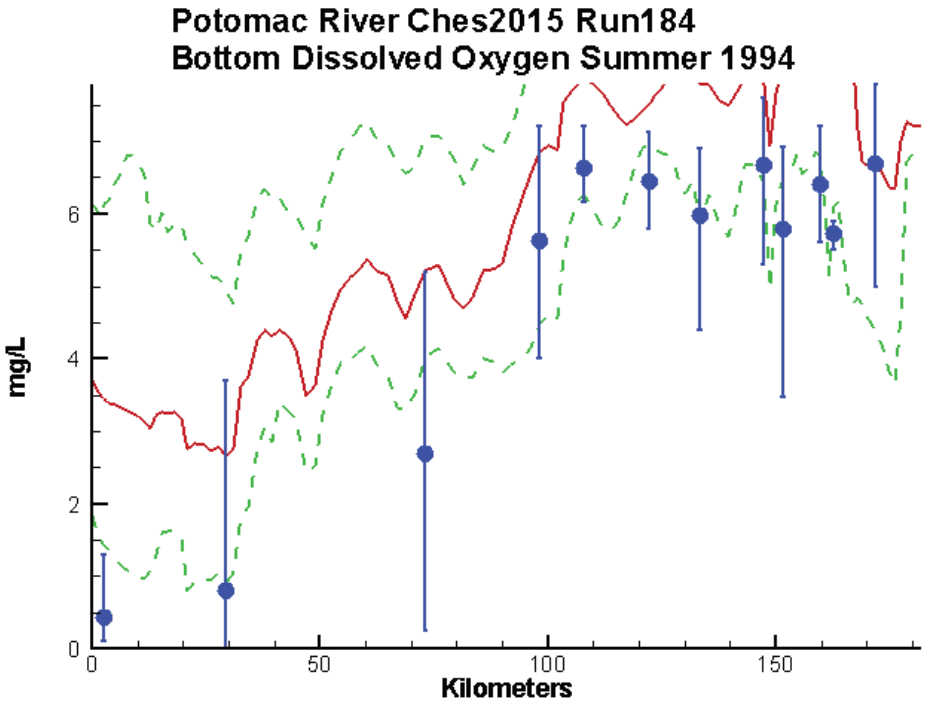


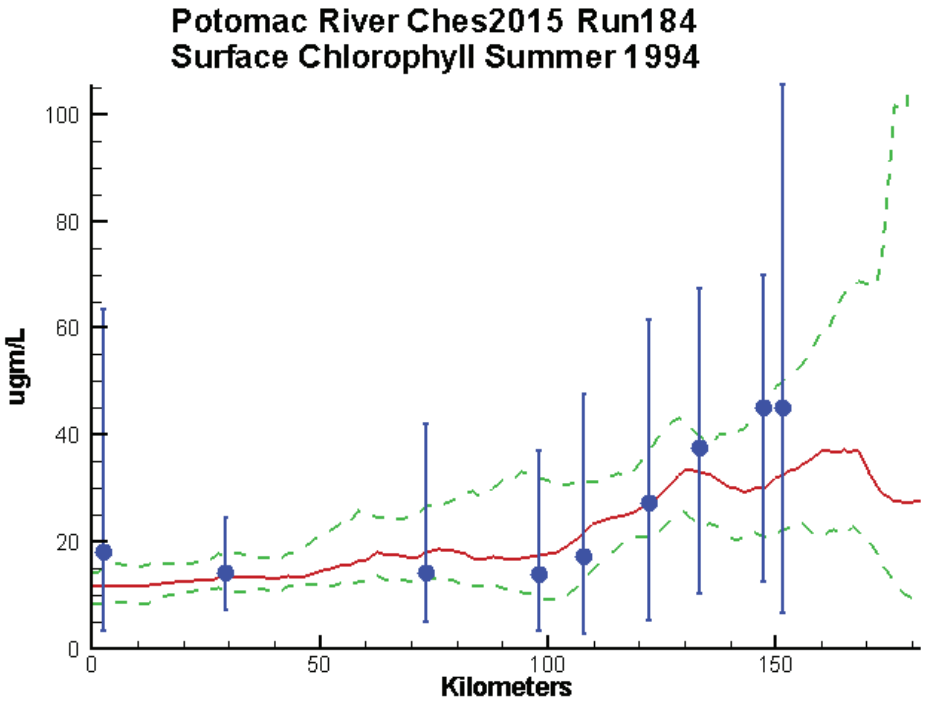


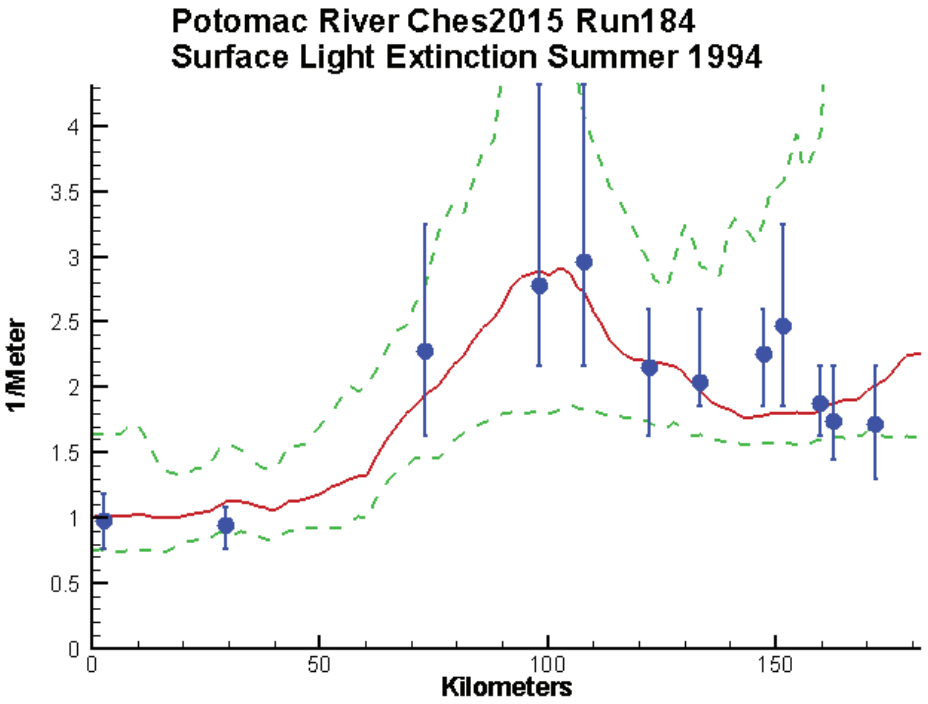


Potomac River - Summer - 1994

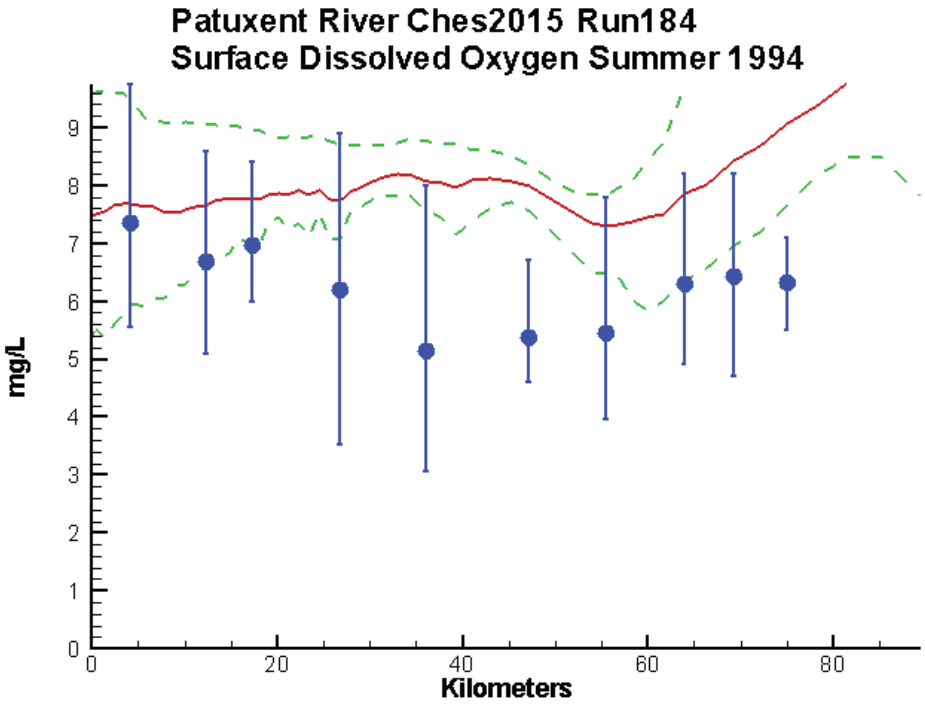


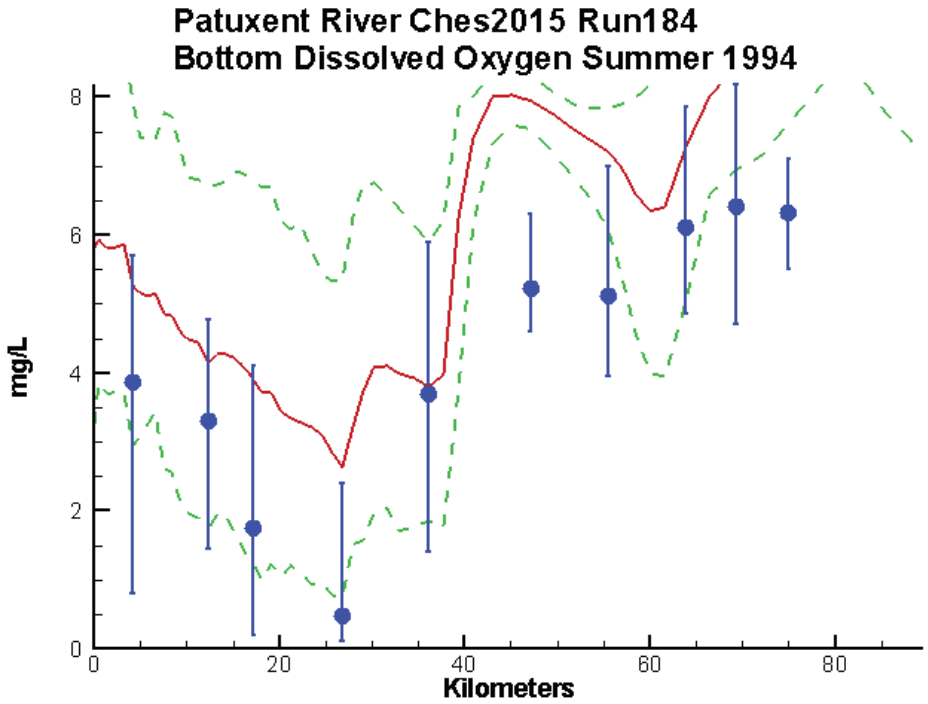


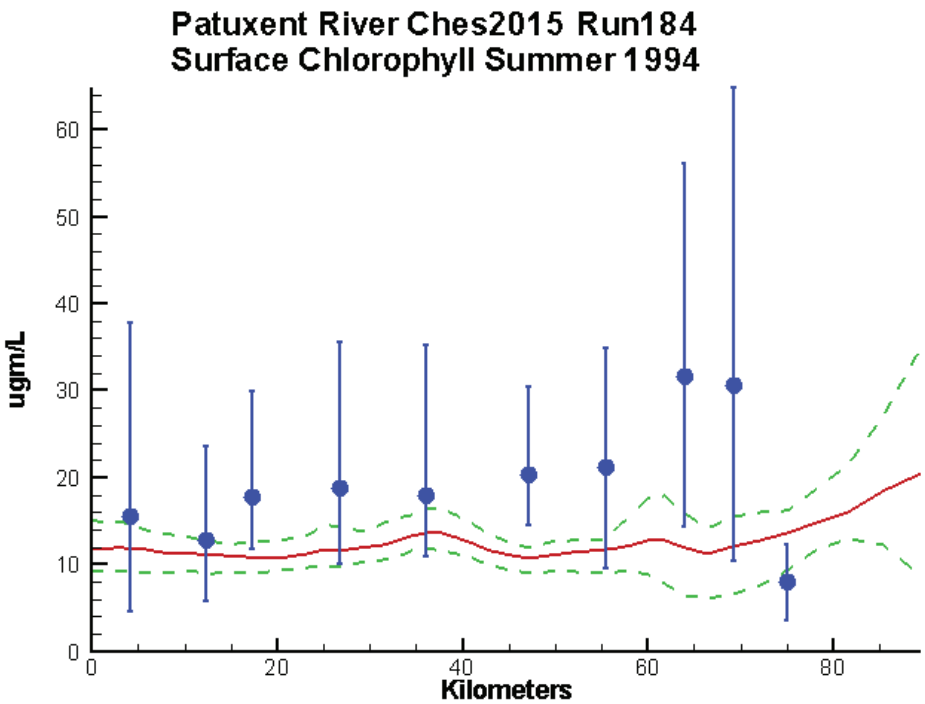


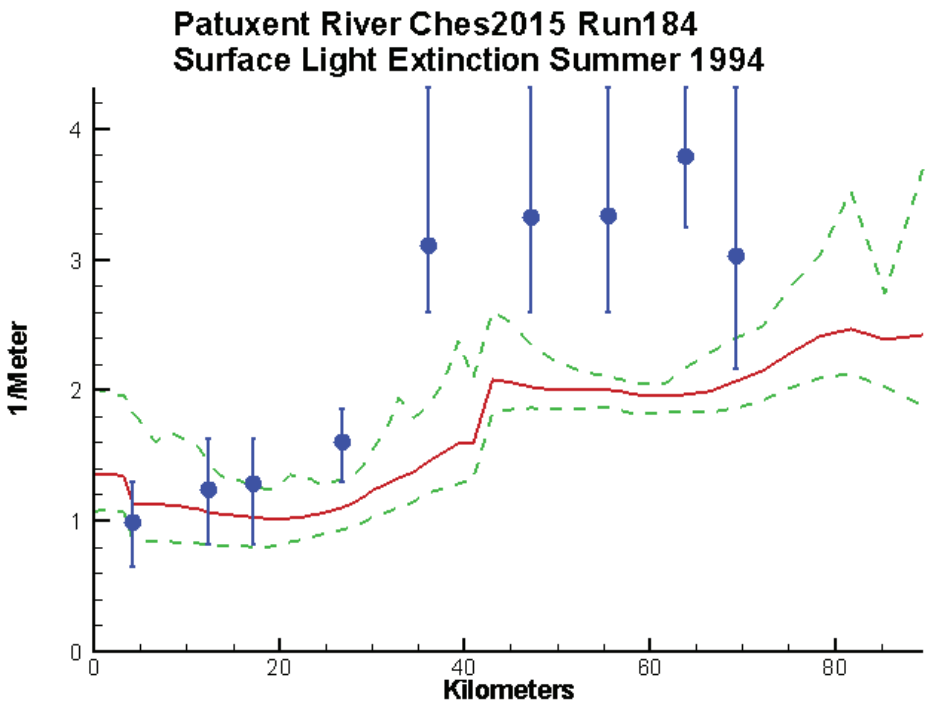


Patuxent River - Summer - 1994

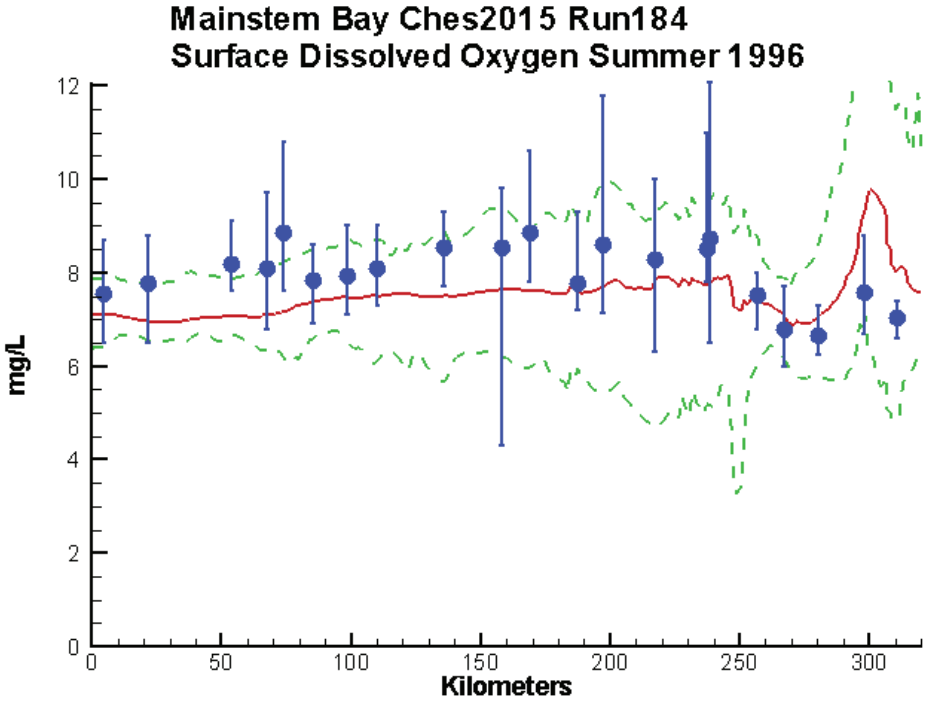


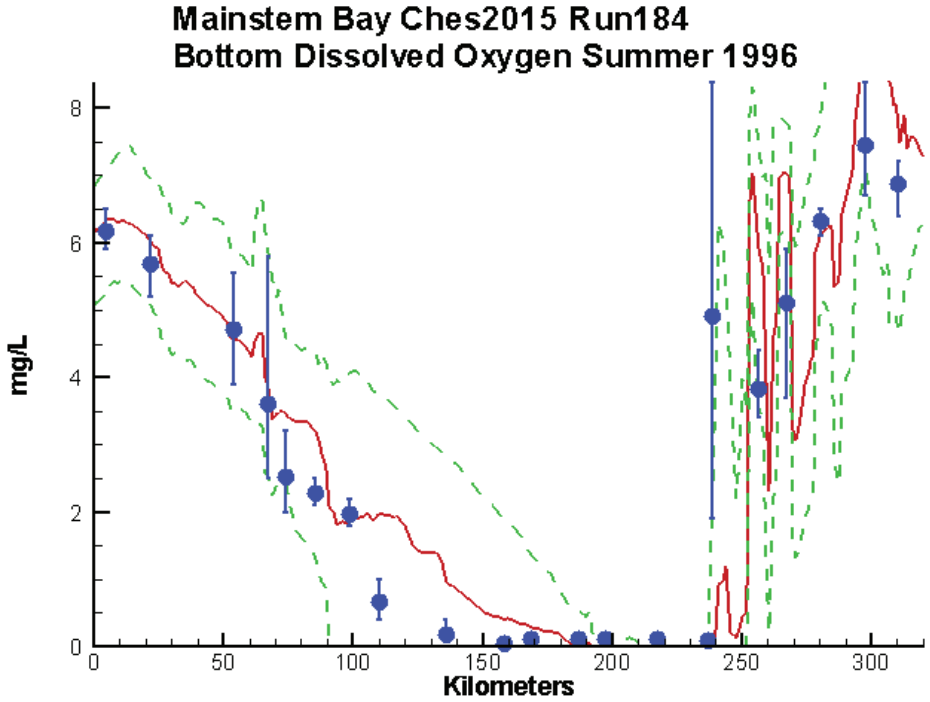


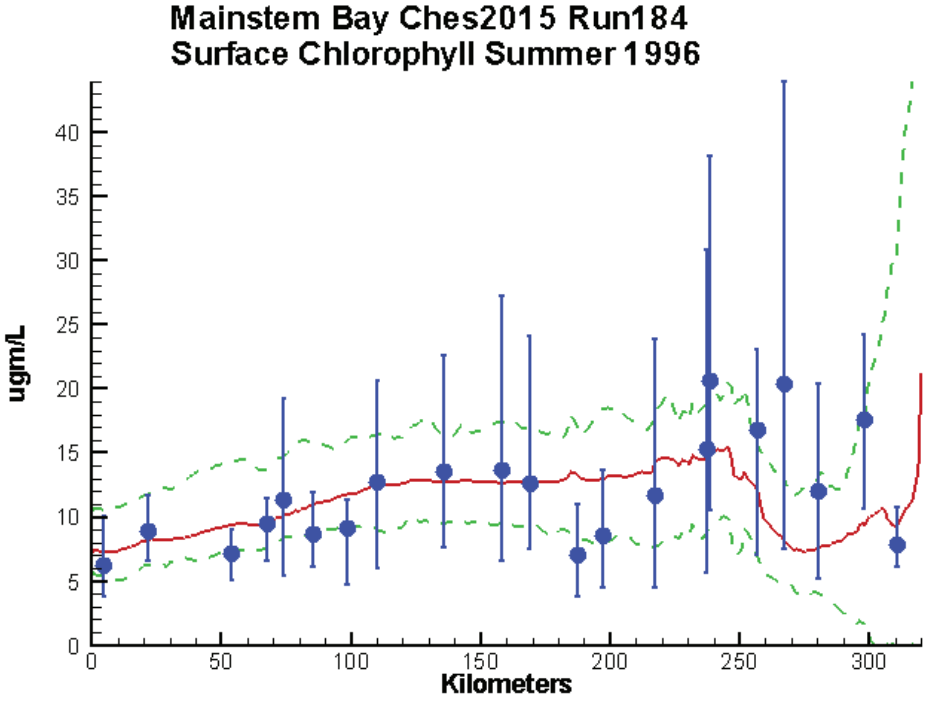


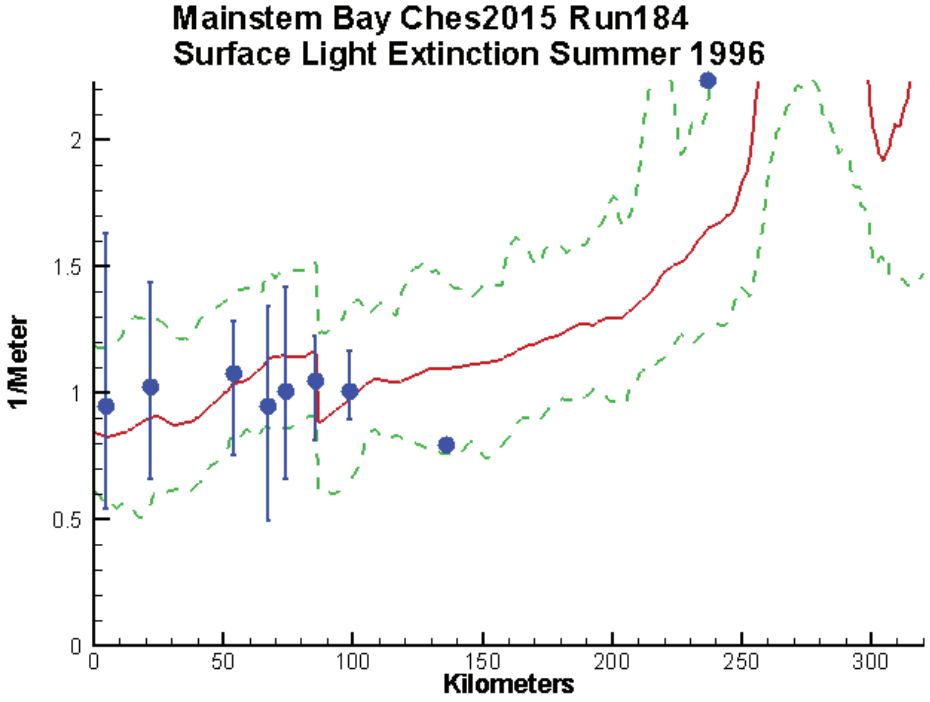


Mainstem Bay - Summer - 1996

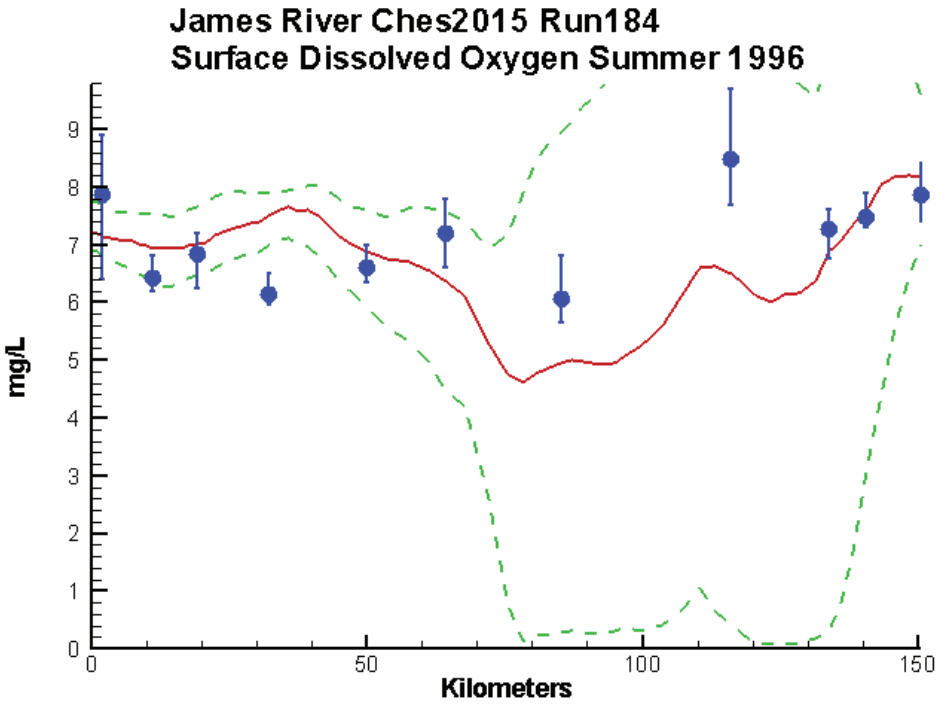


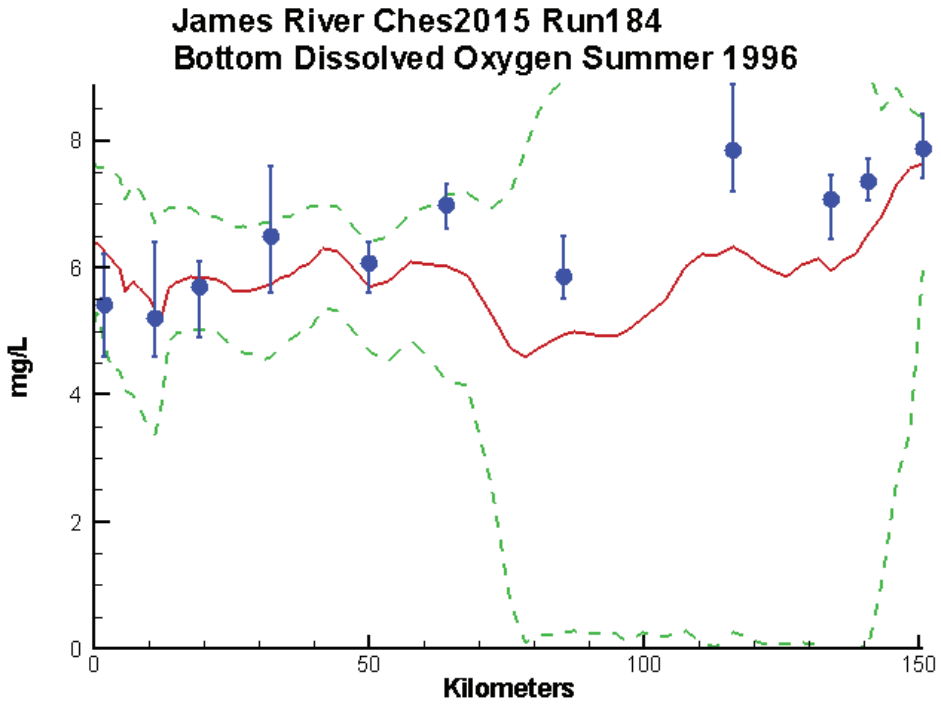


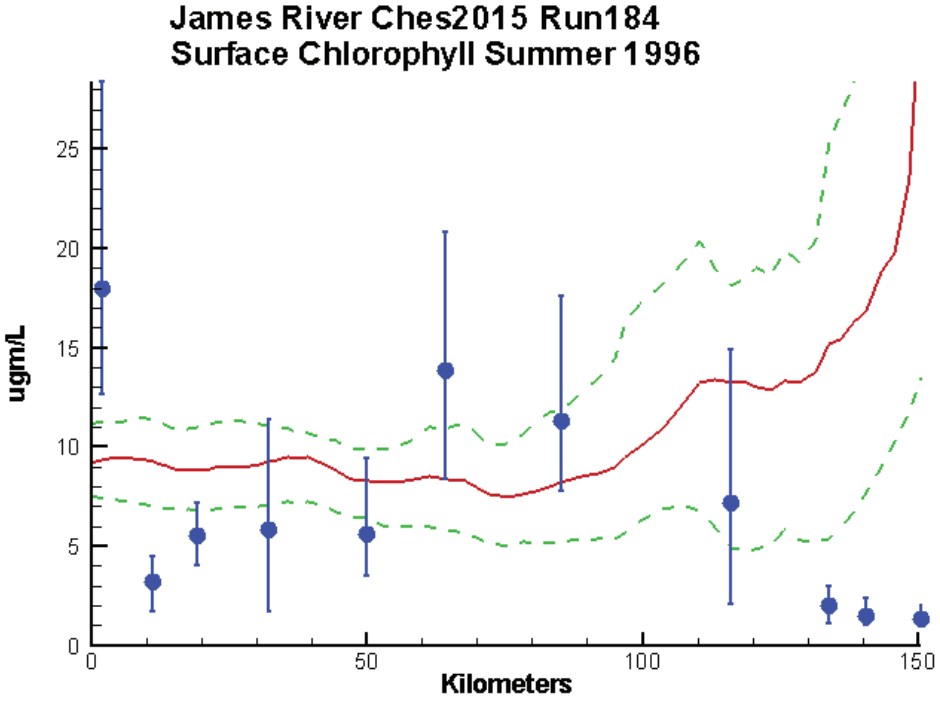


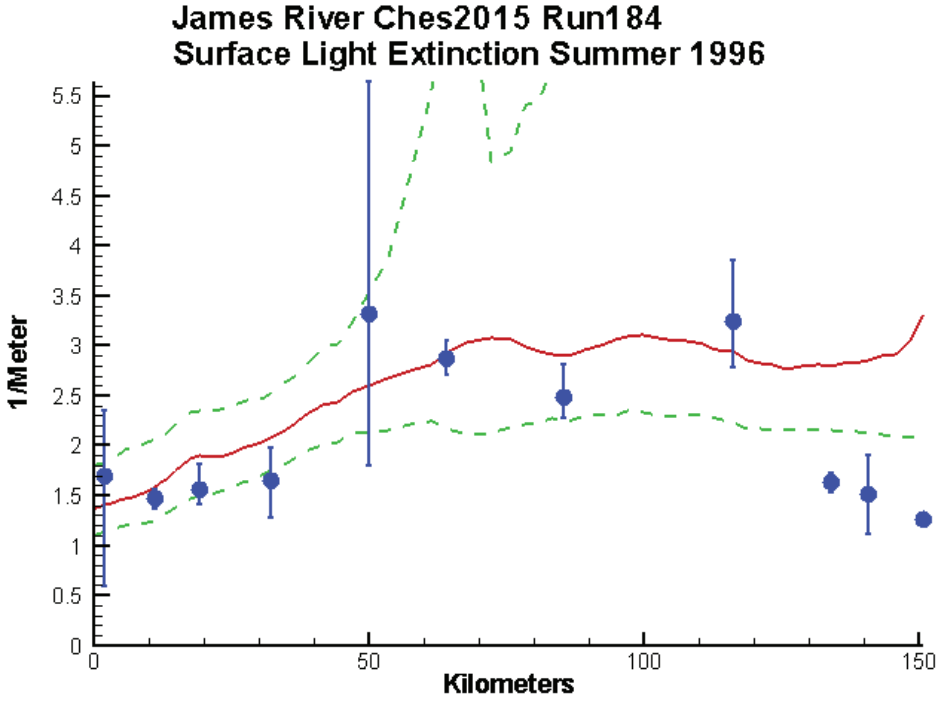


James River - Summer - 1996

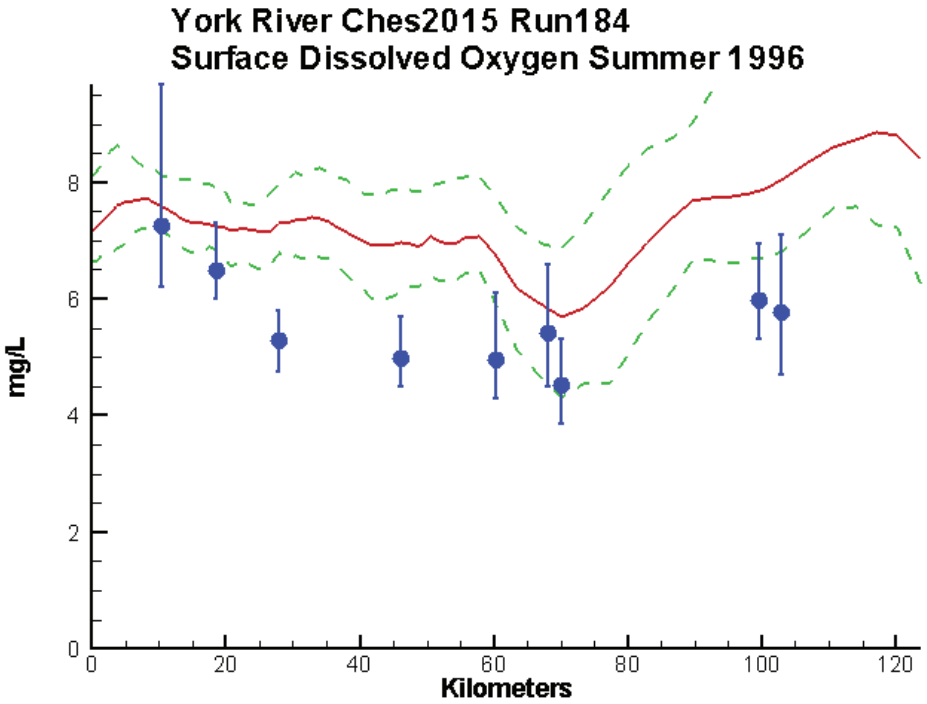


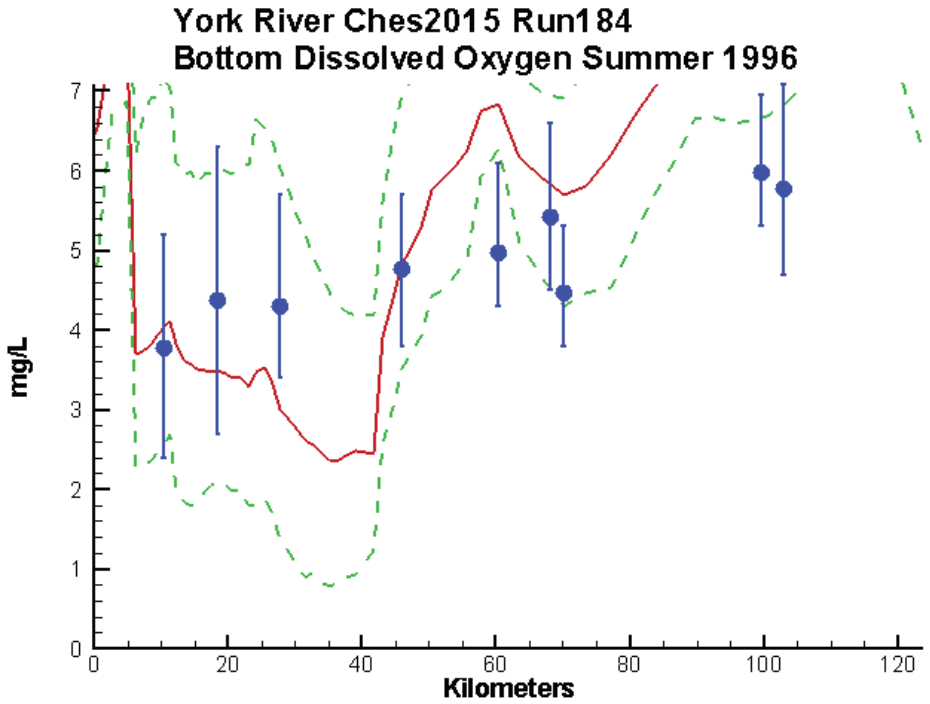


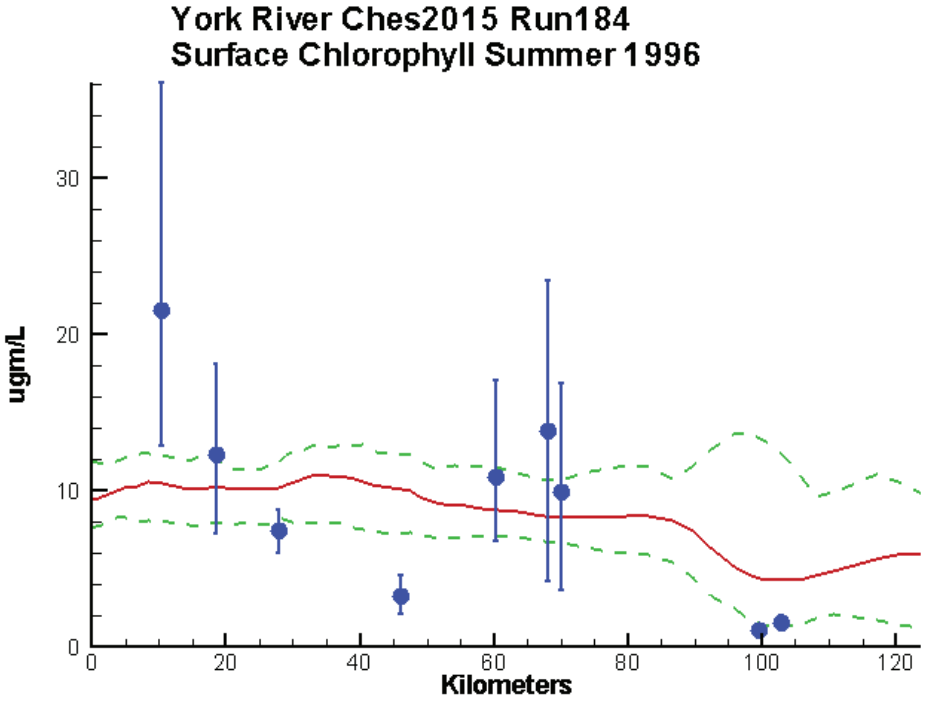


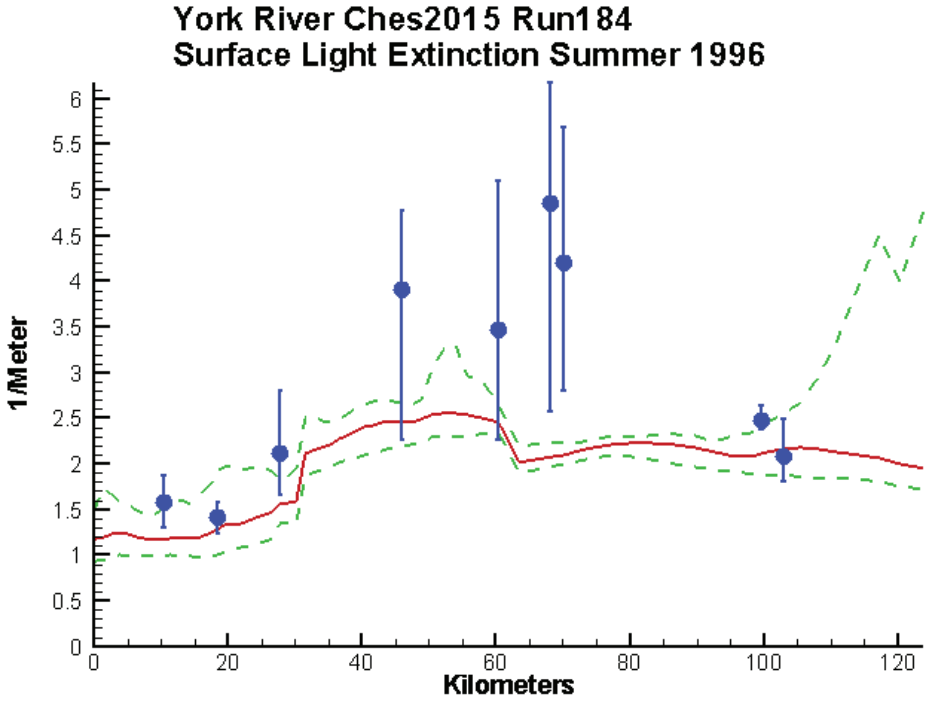


York River - Summer - 1996

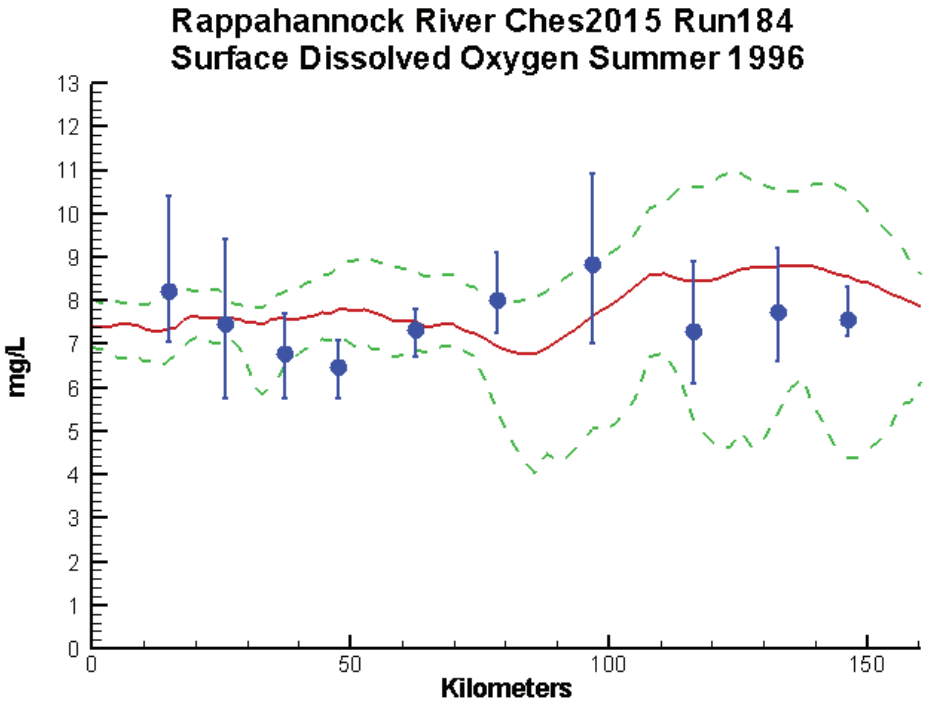


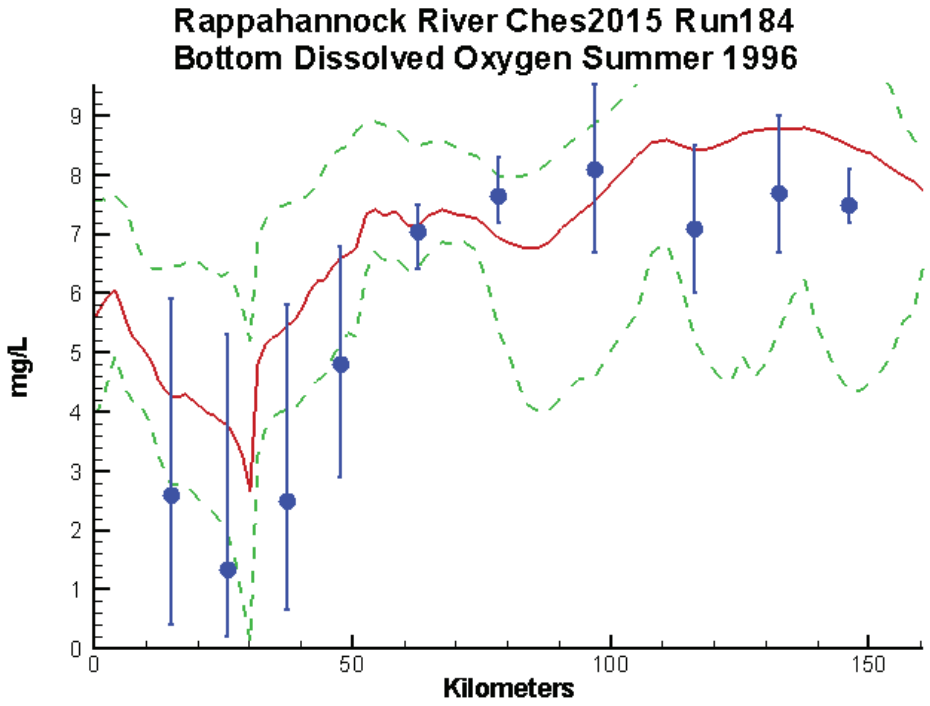


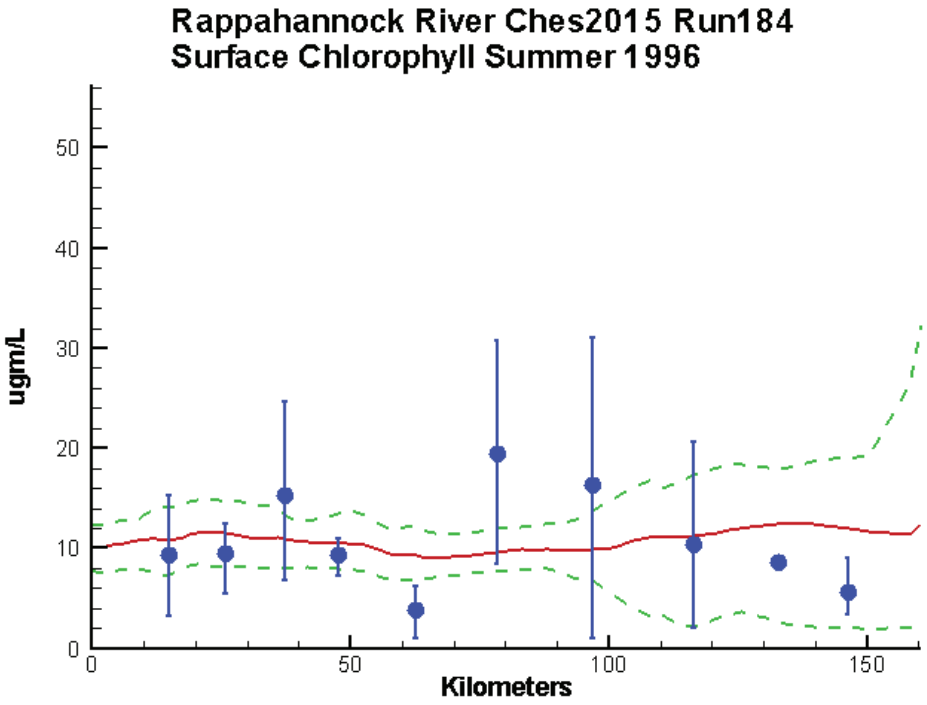


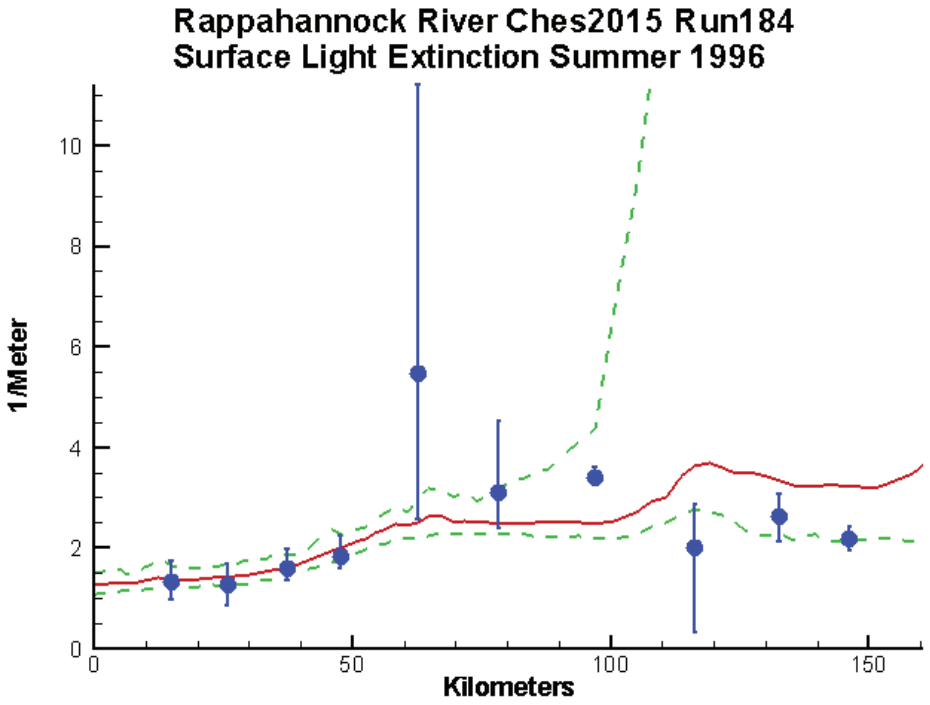


Rappahannock River - Summer - 1996

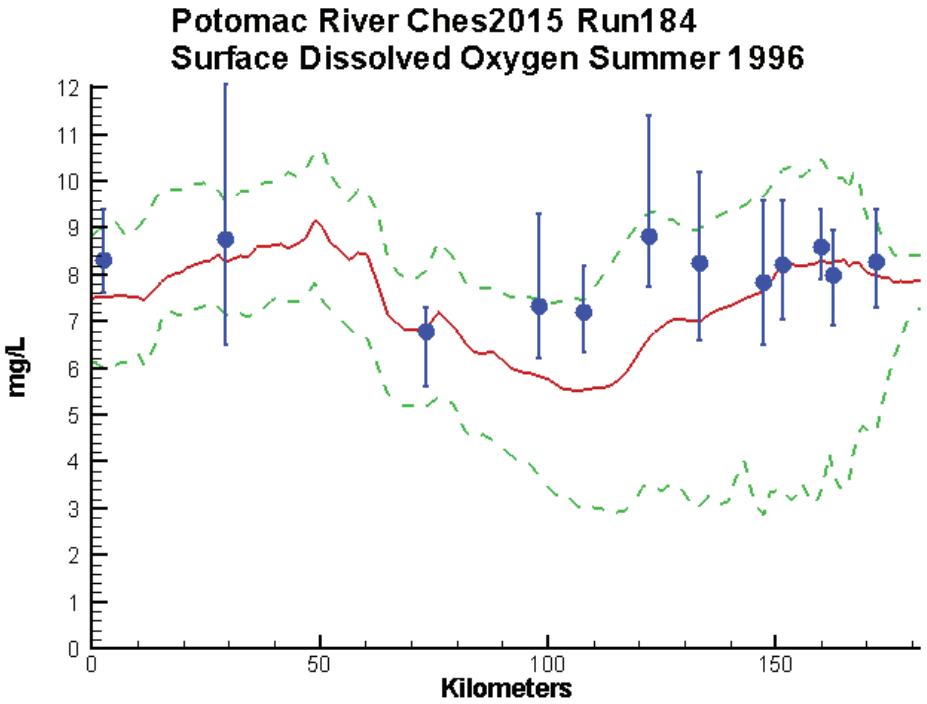


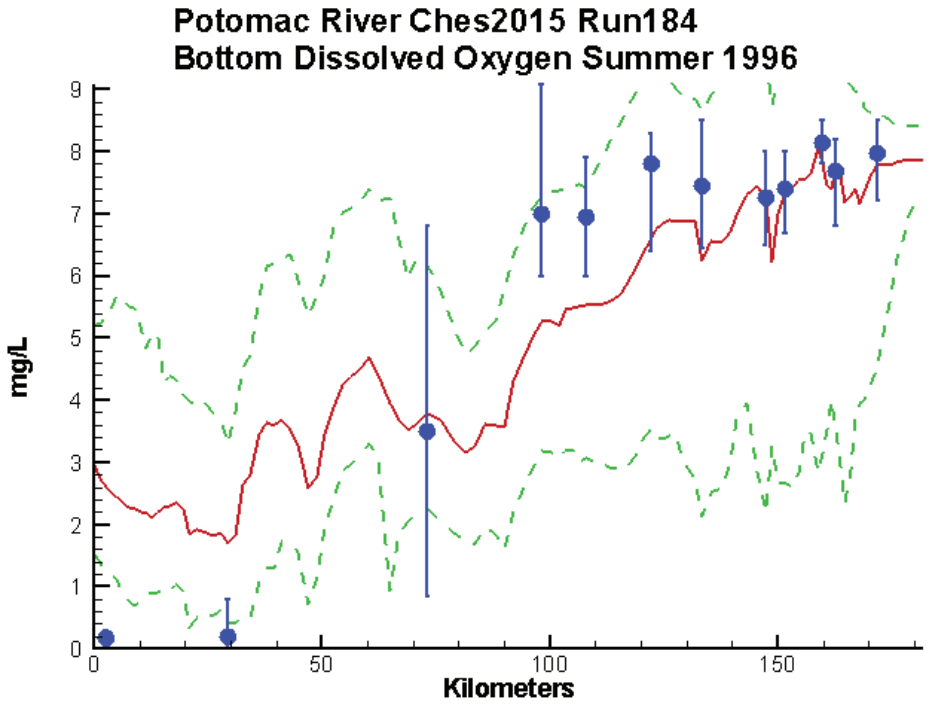


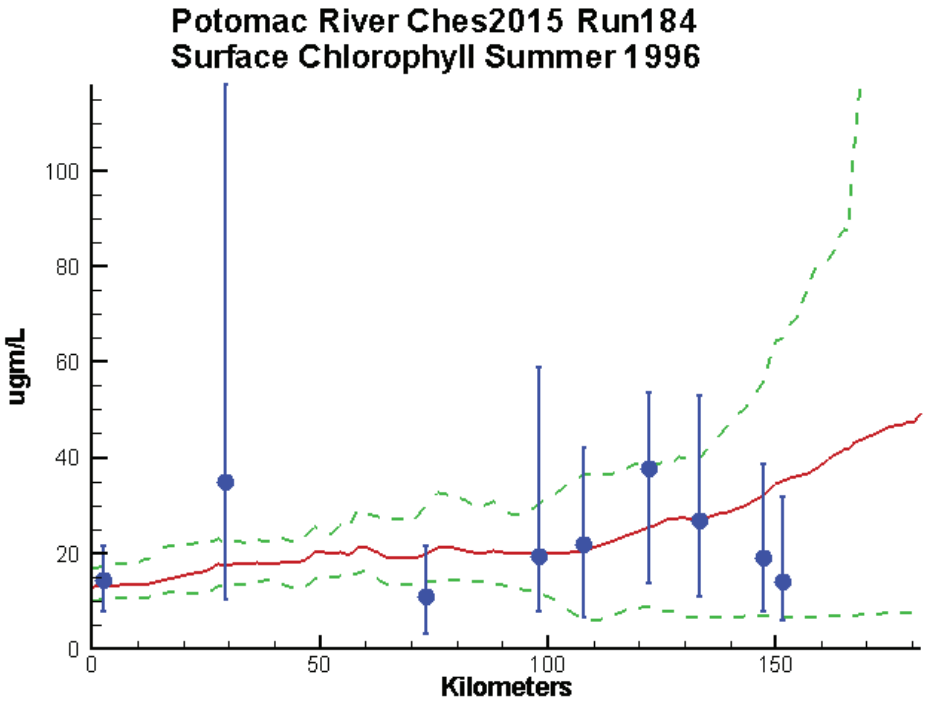


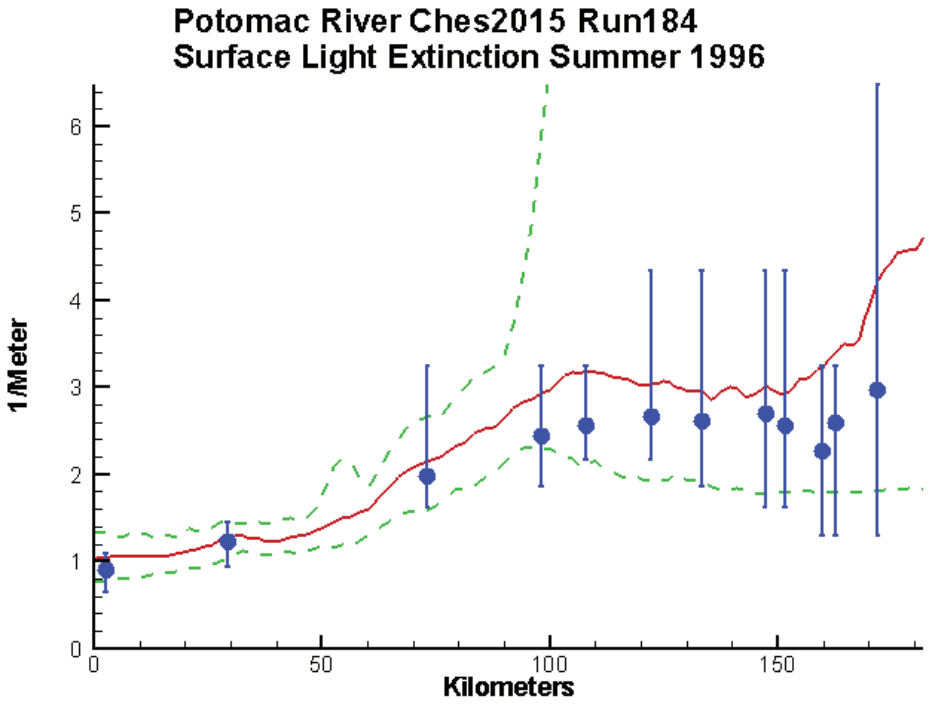


Potomac River - Summer - 1996

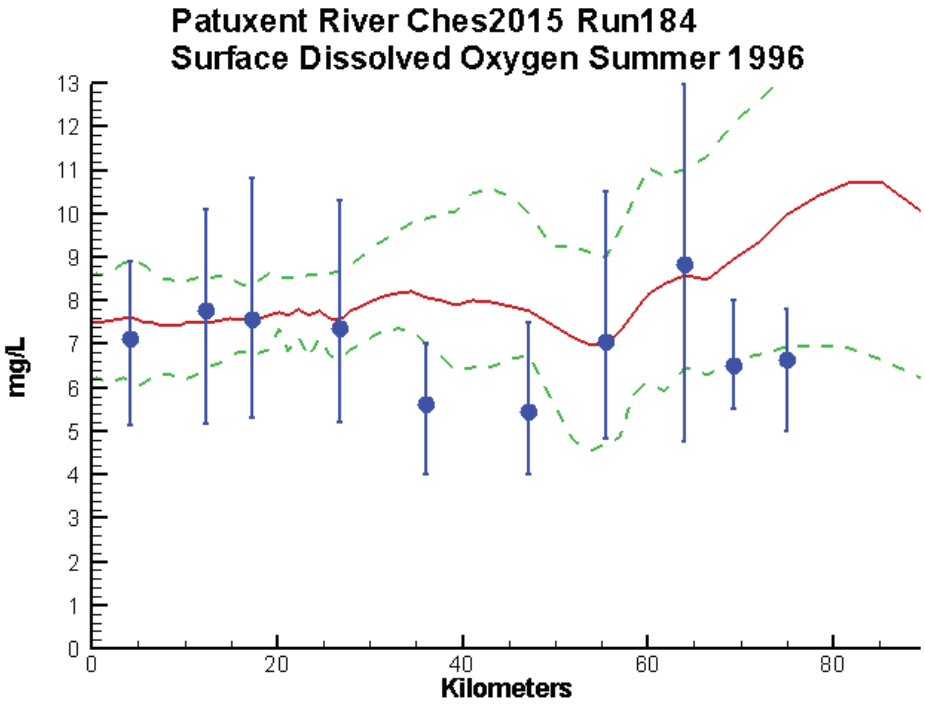


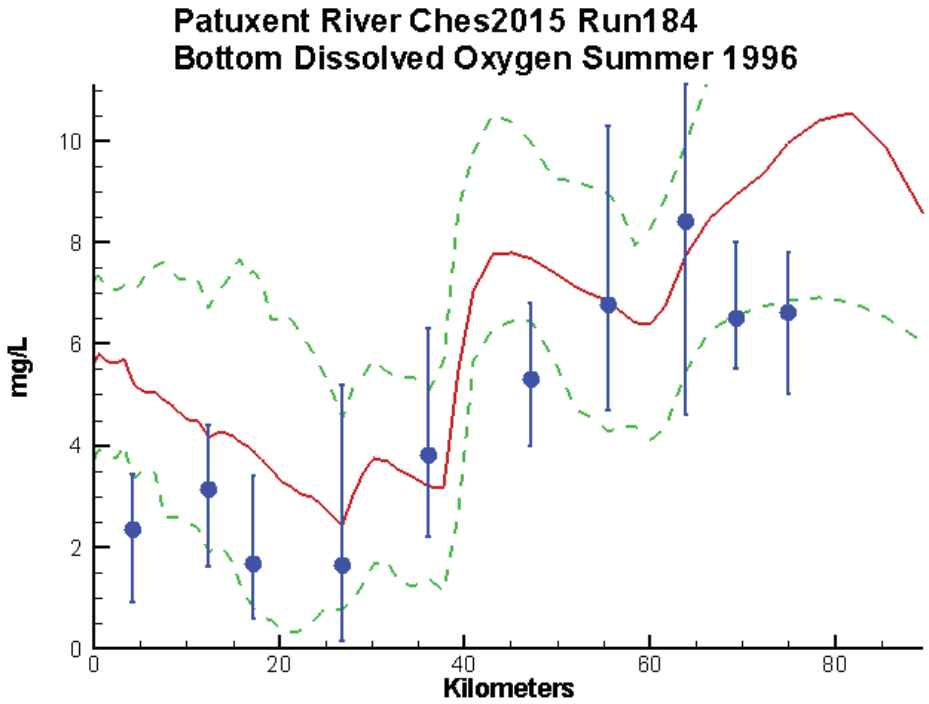


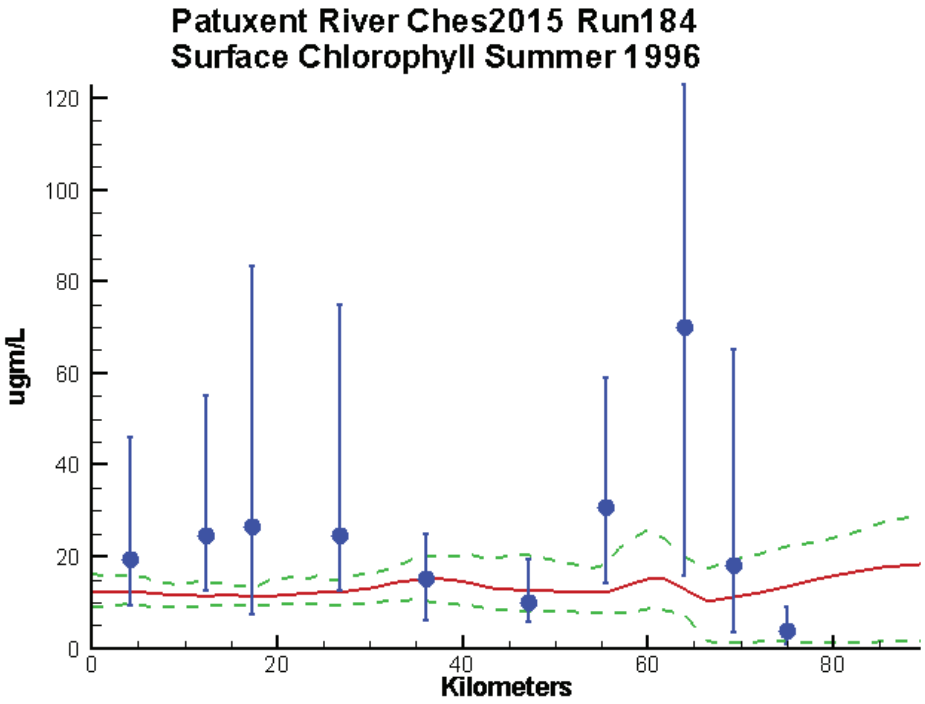


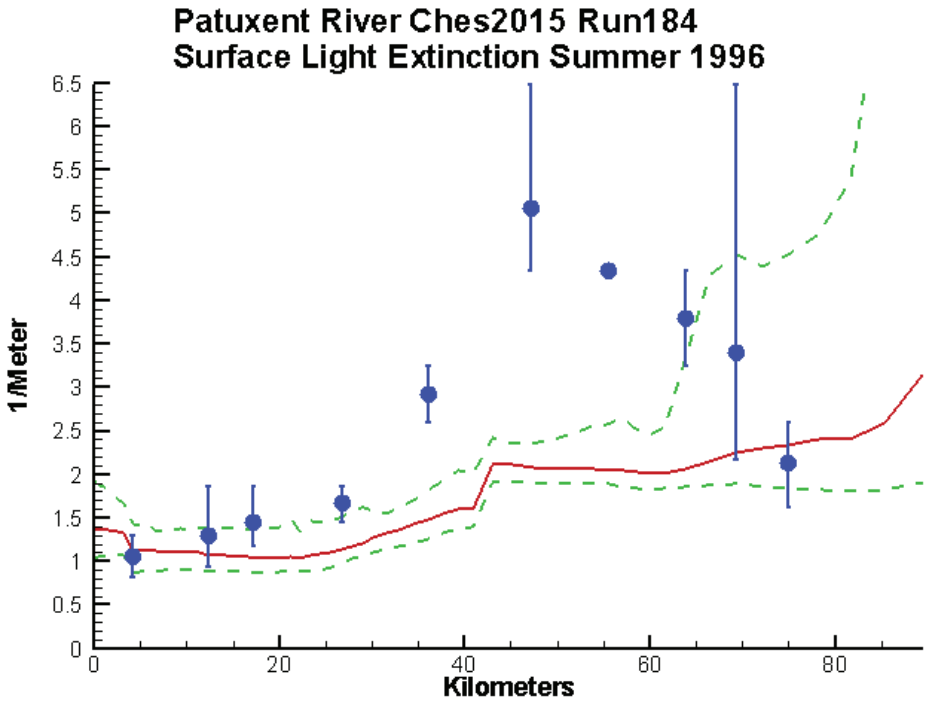


Patuxent River - Summer - 1996

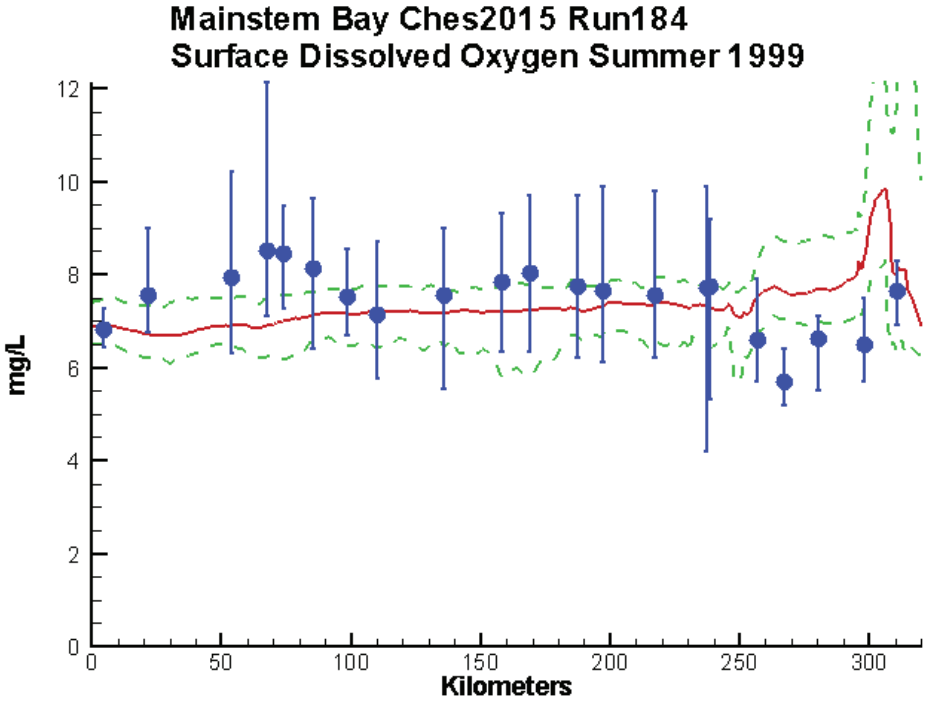


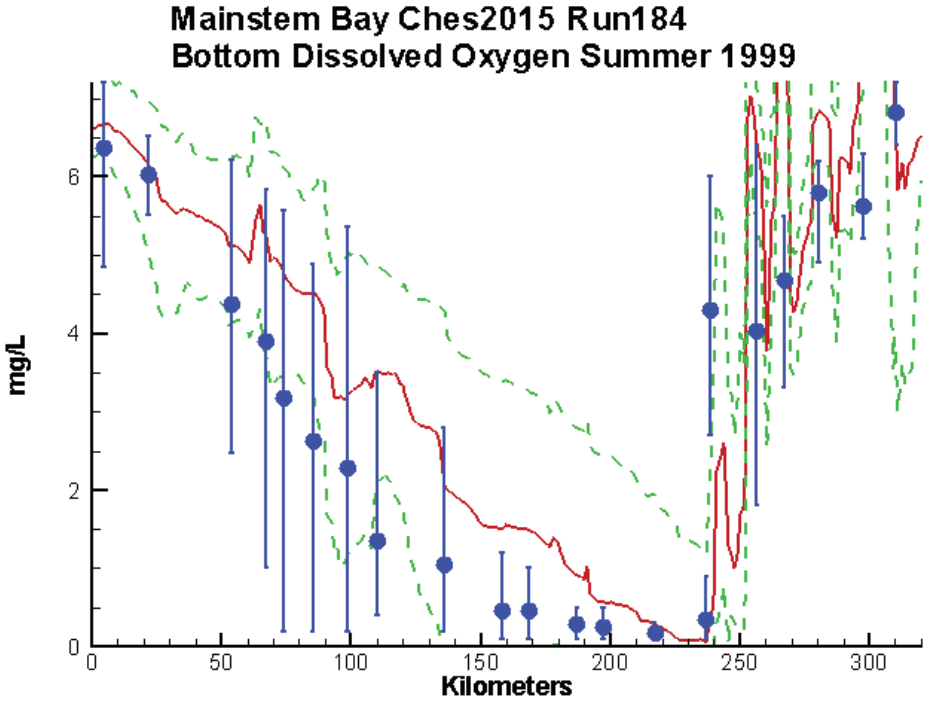


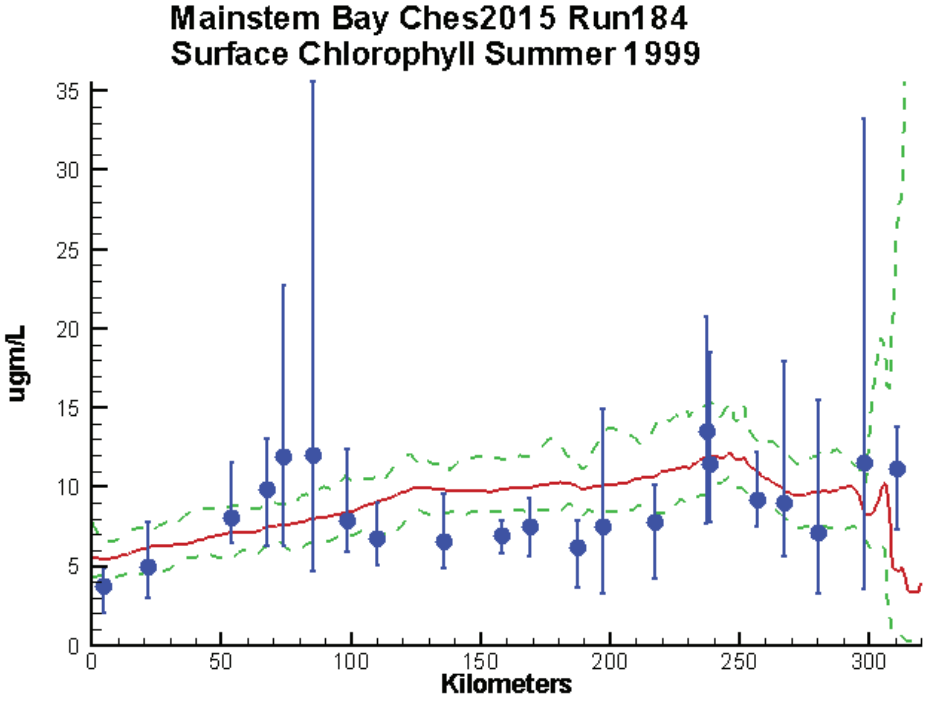


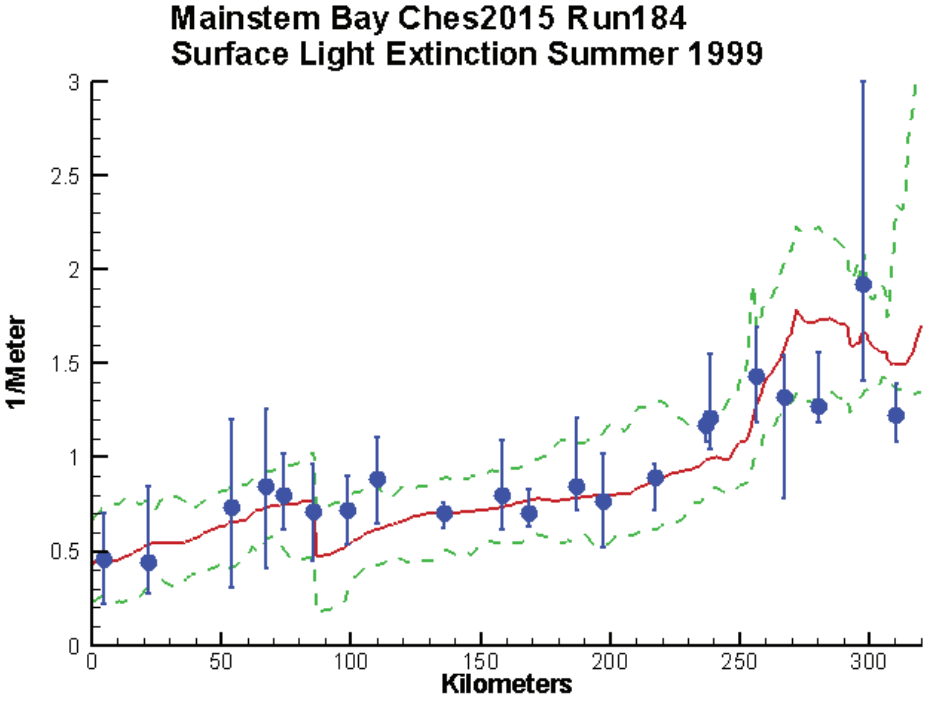


Mainstem Bay - Summer - 1999

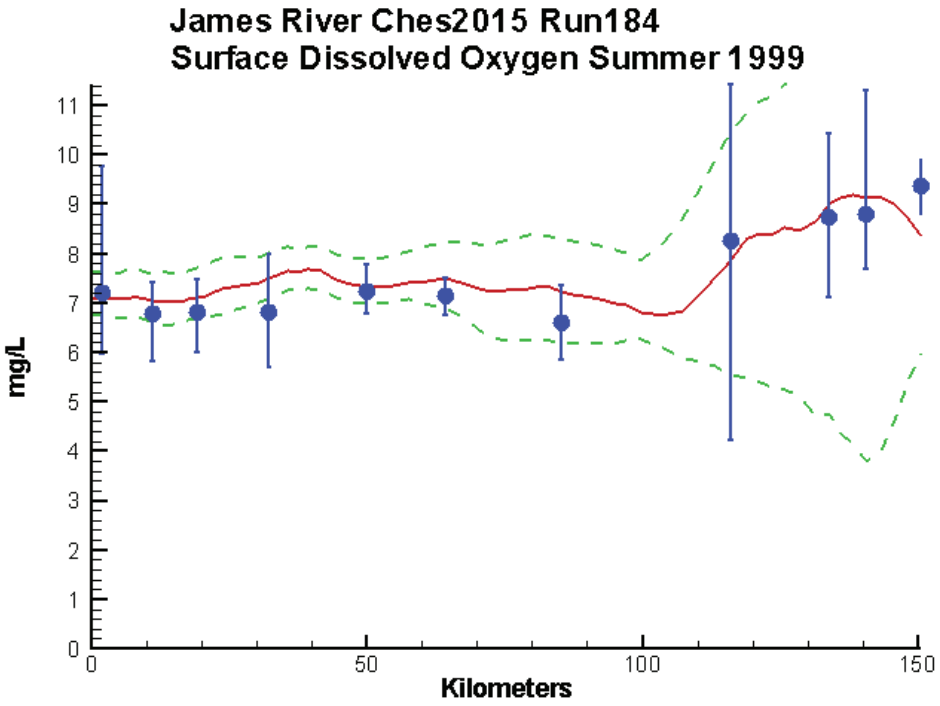


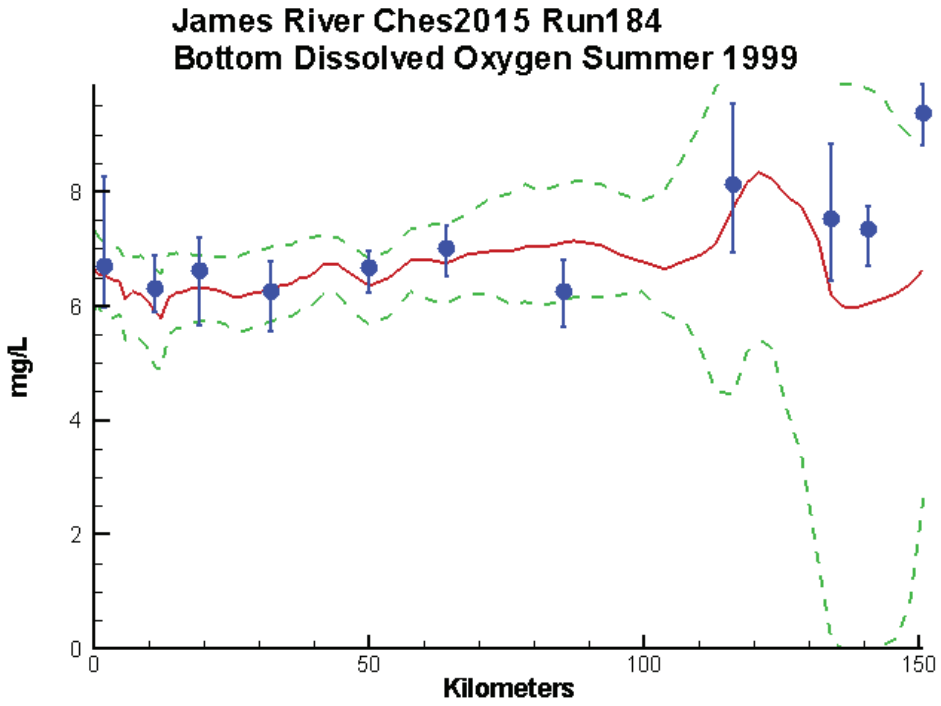


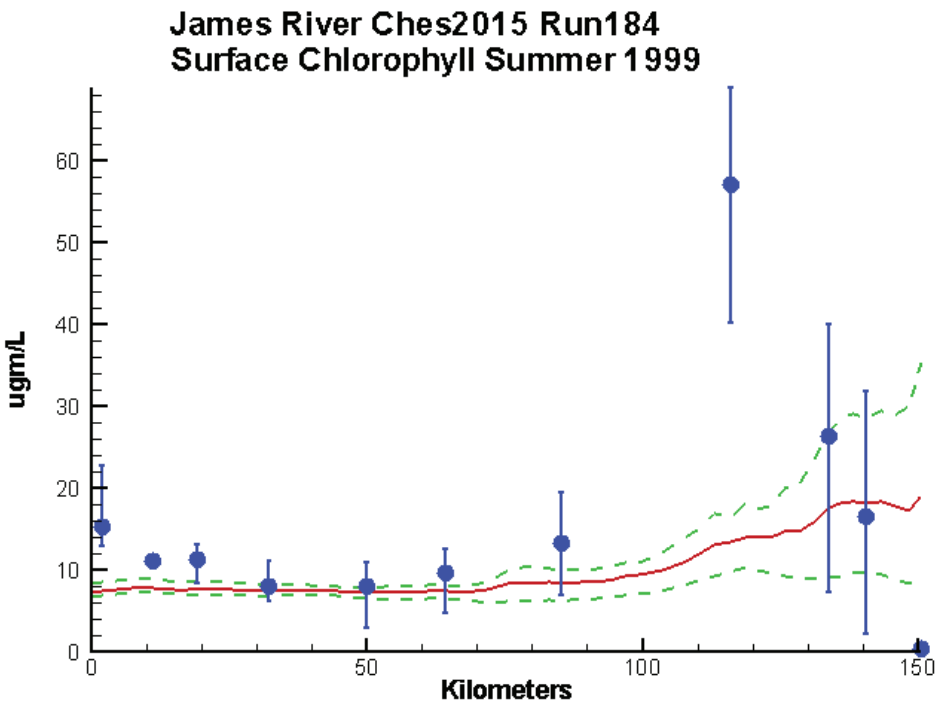


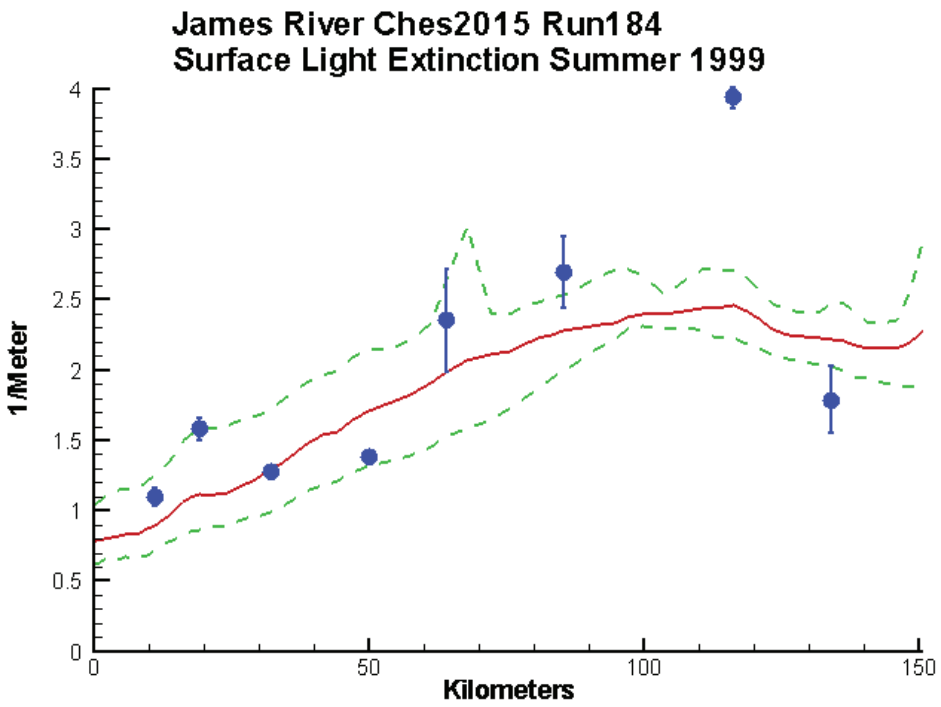


James River - Summer - 1999

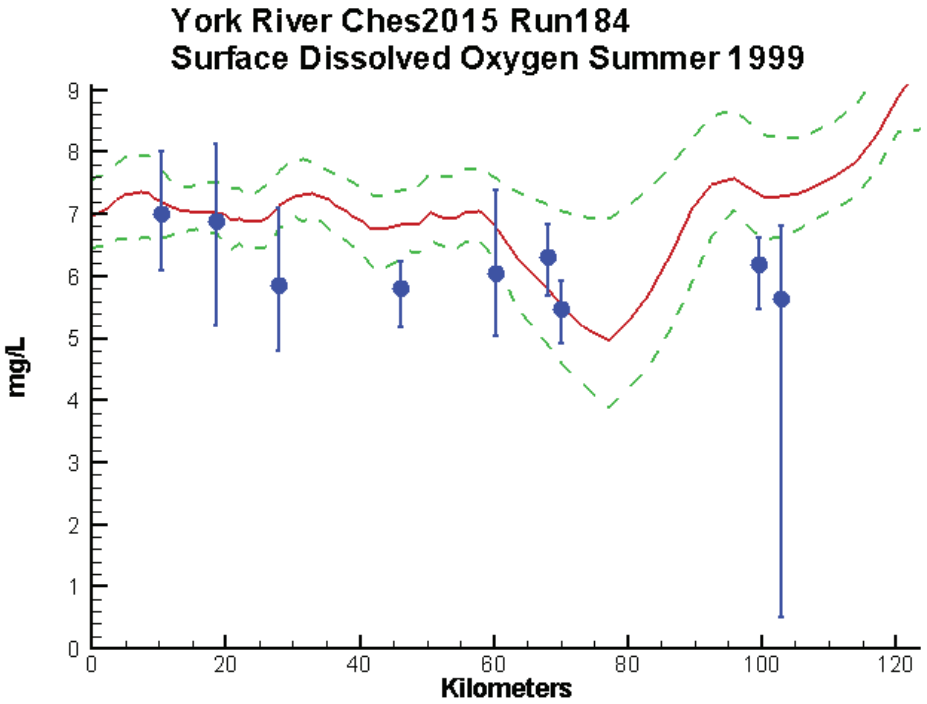


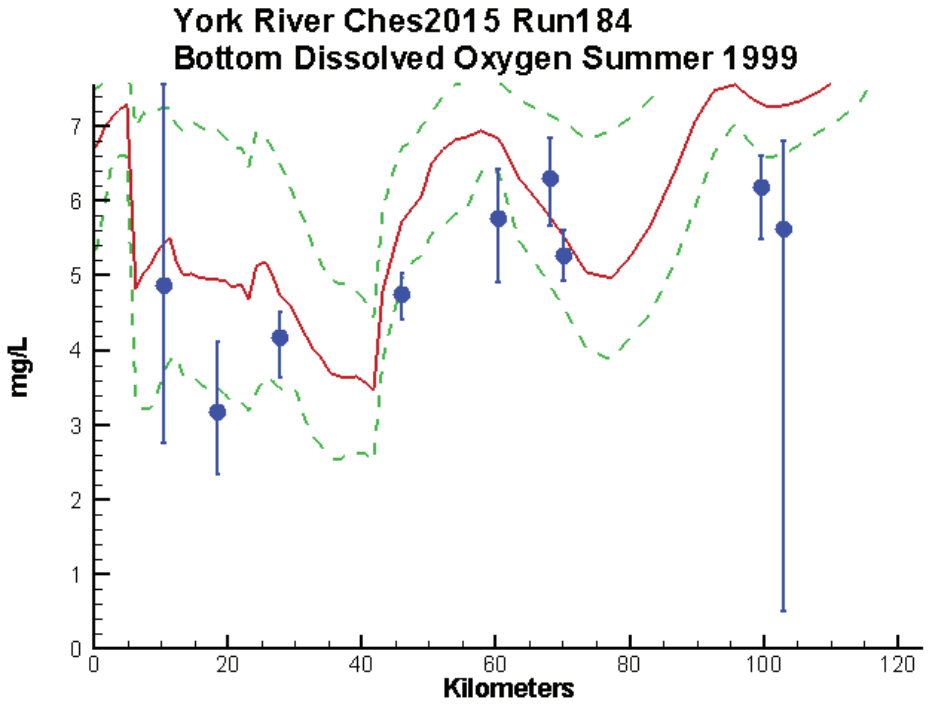


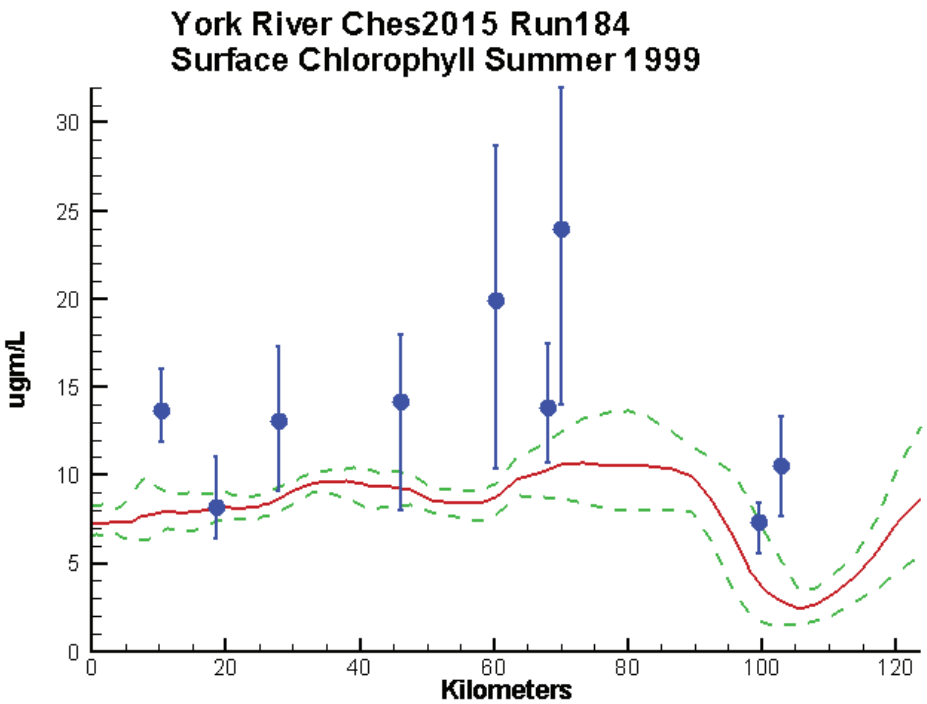


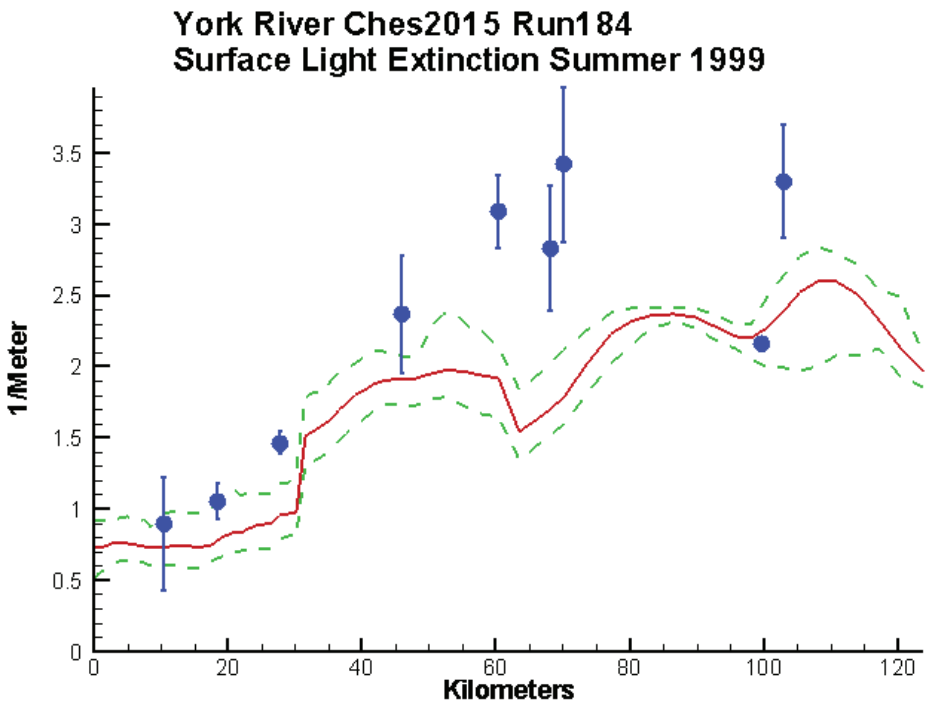


York River - Summer - 1999

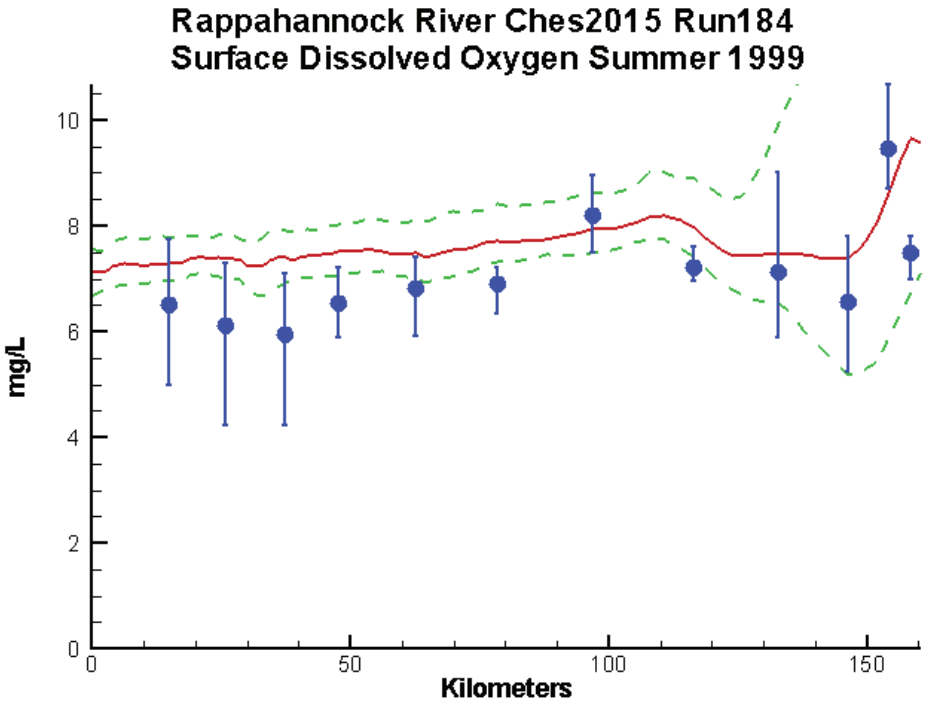


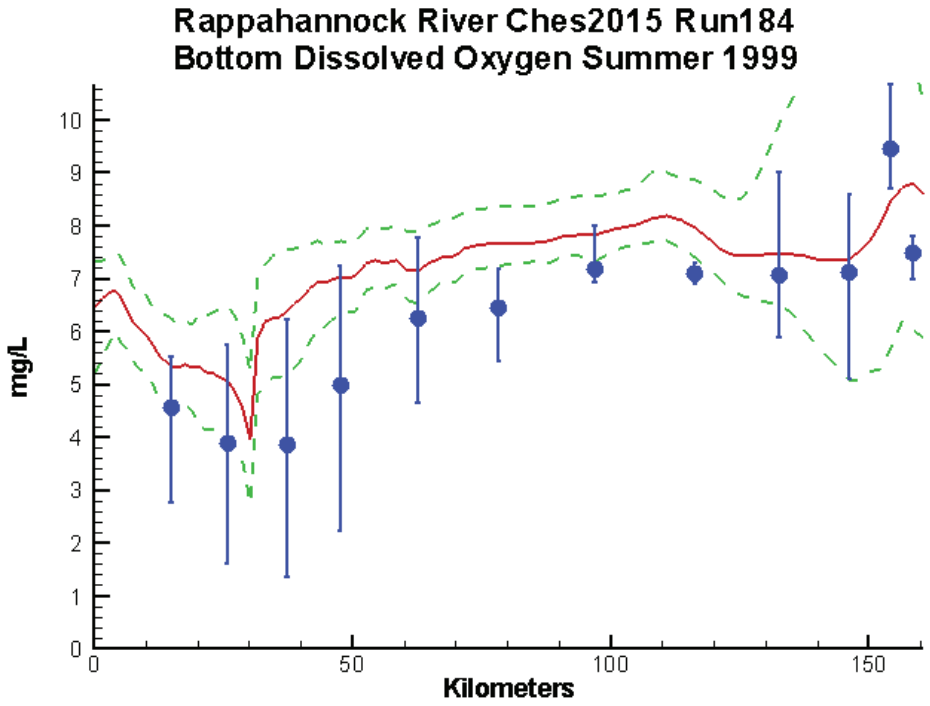


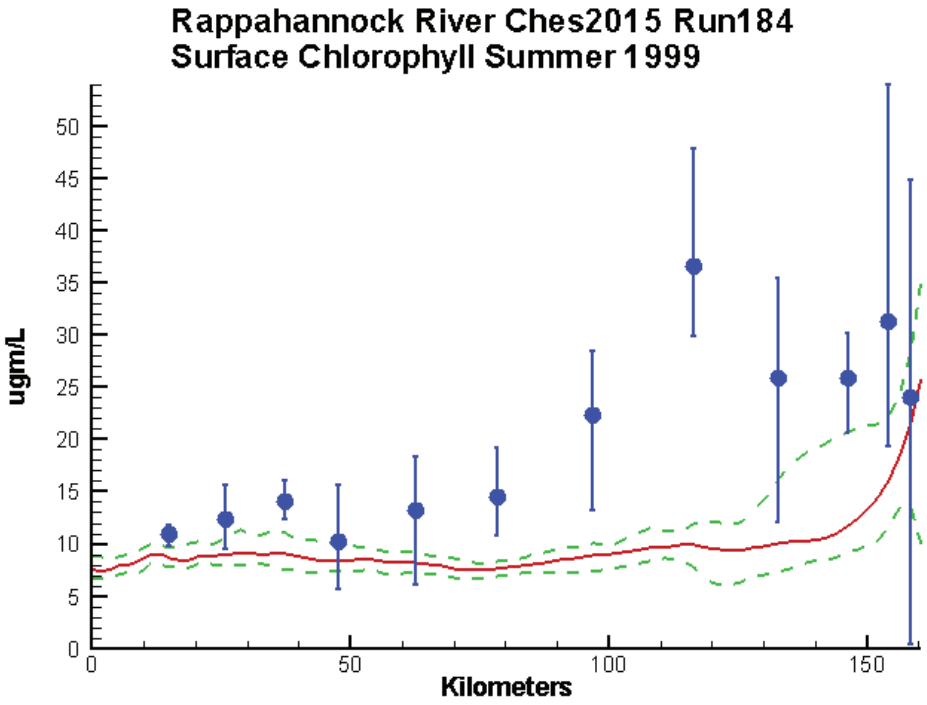


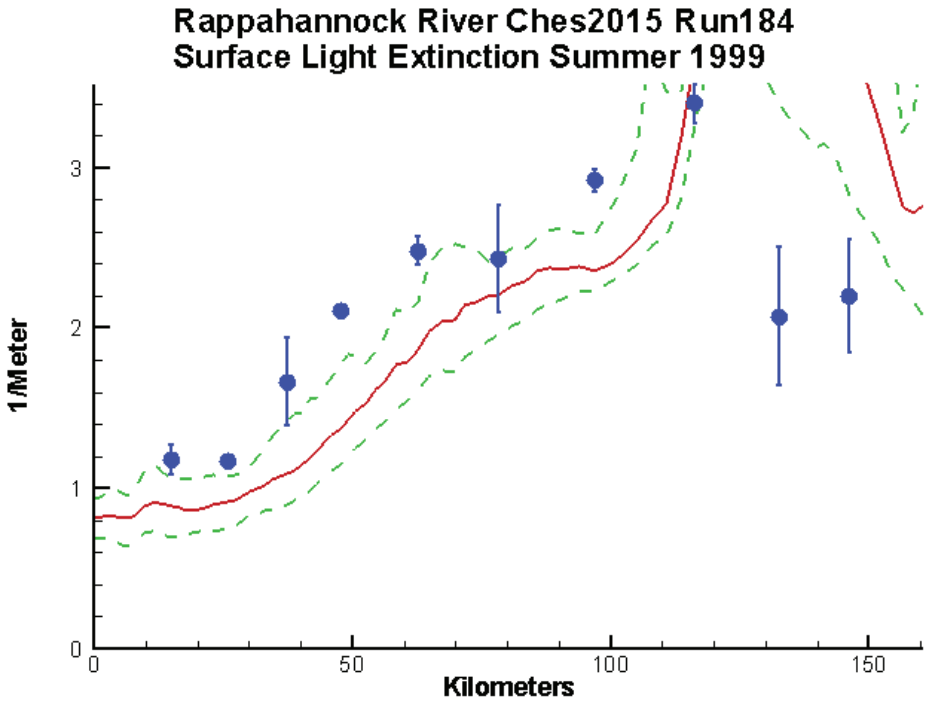


Rappahannock River - Summer - 1999

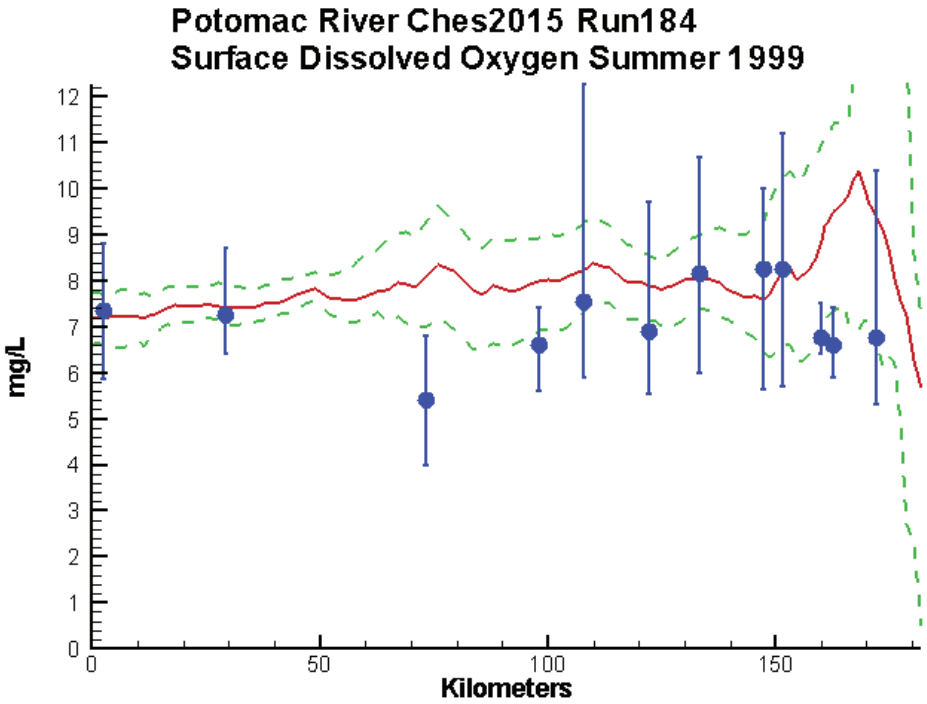


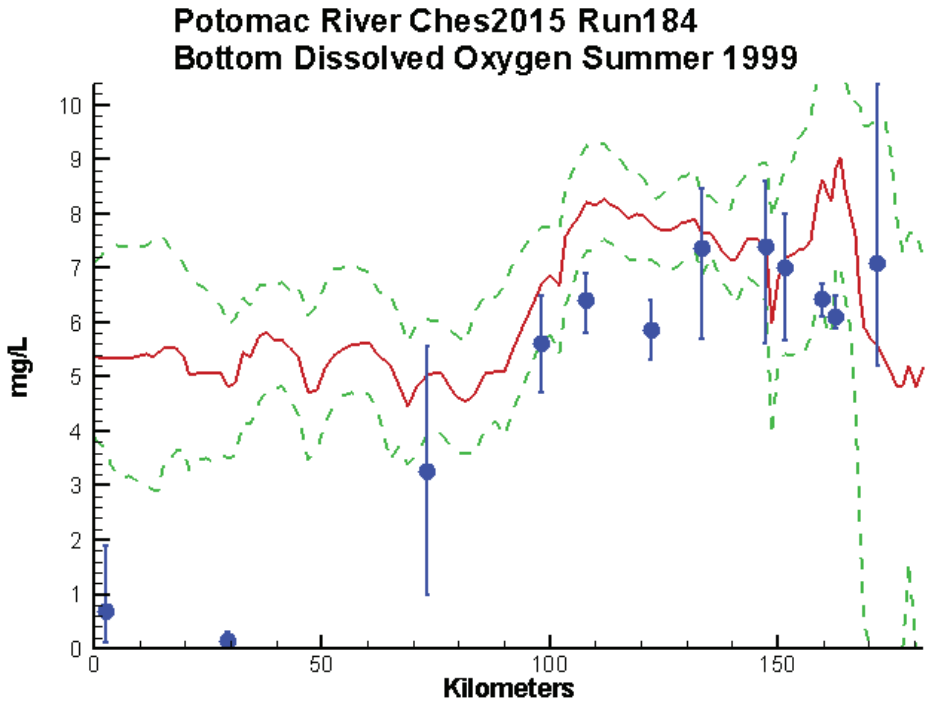


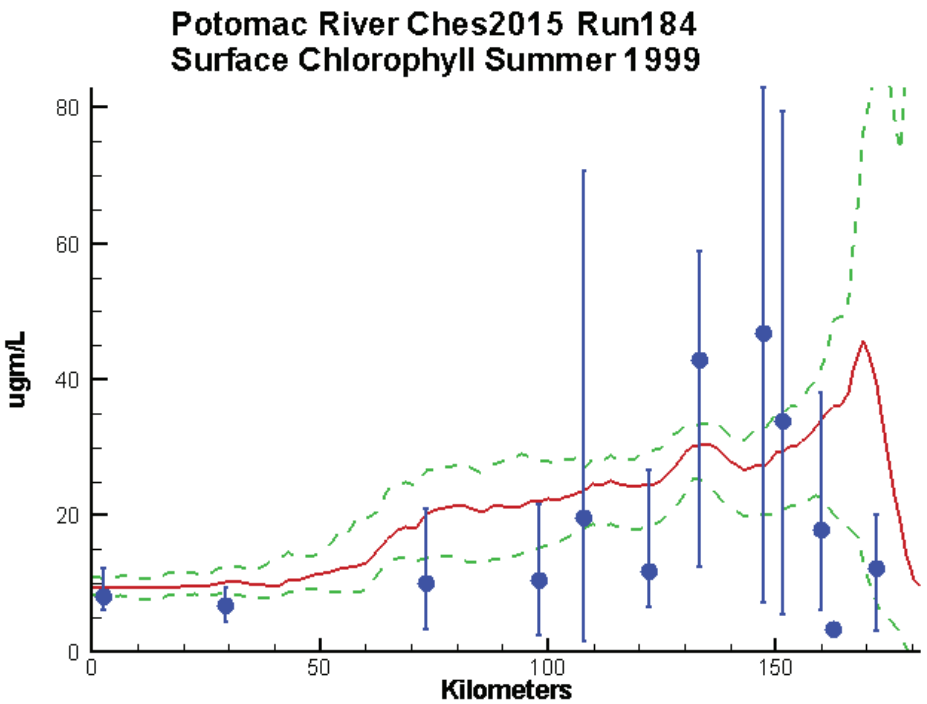


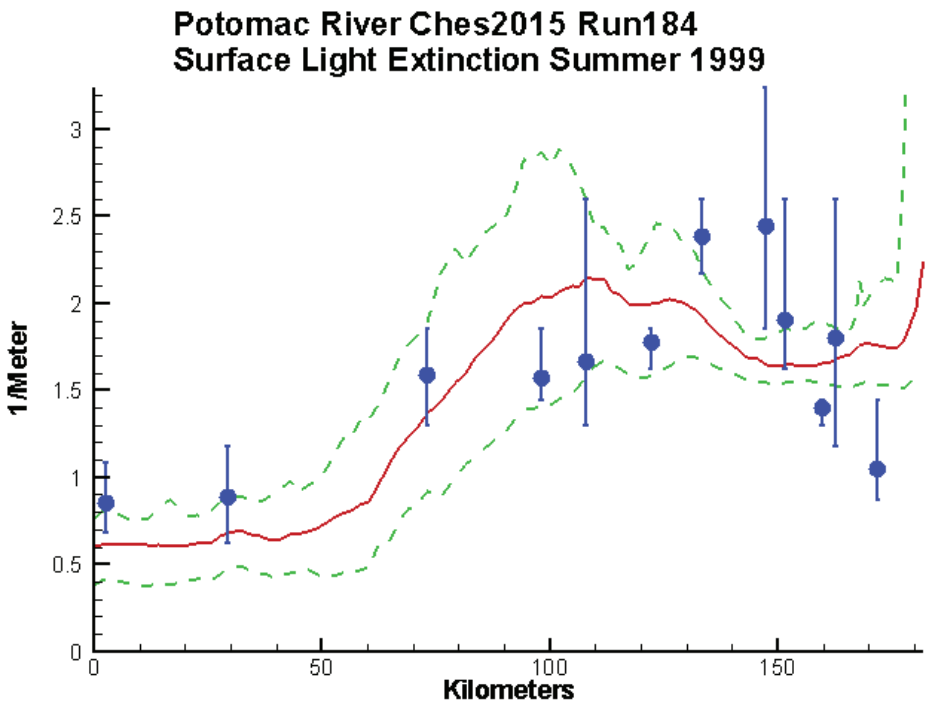


Potomac River - Summer - 1999

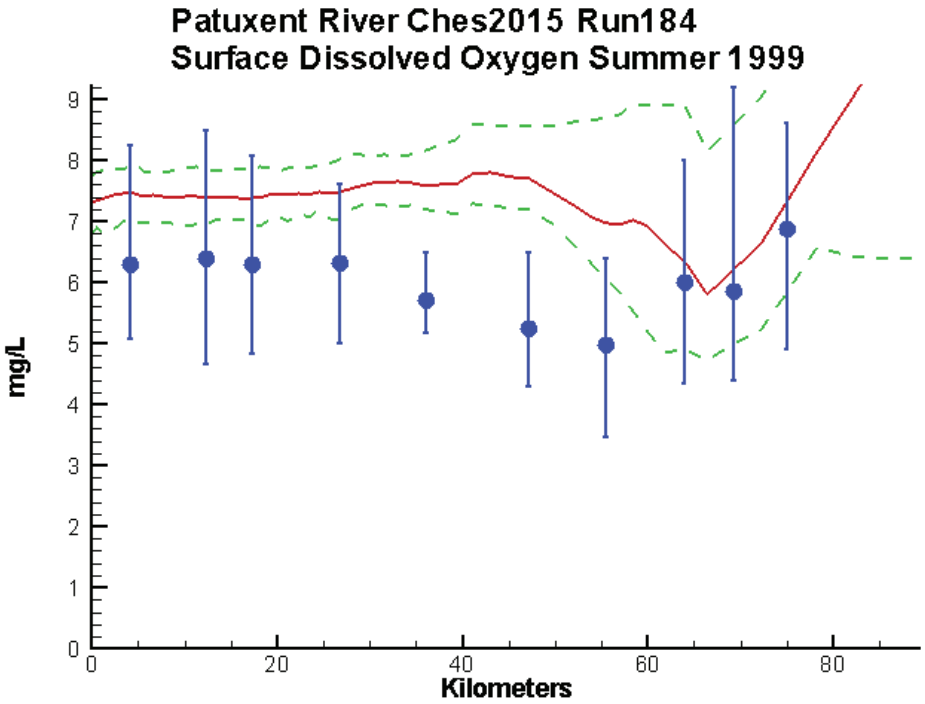


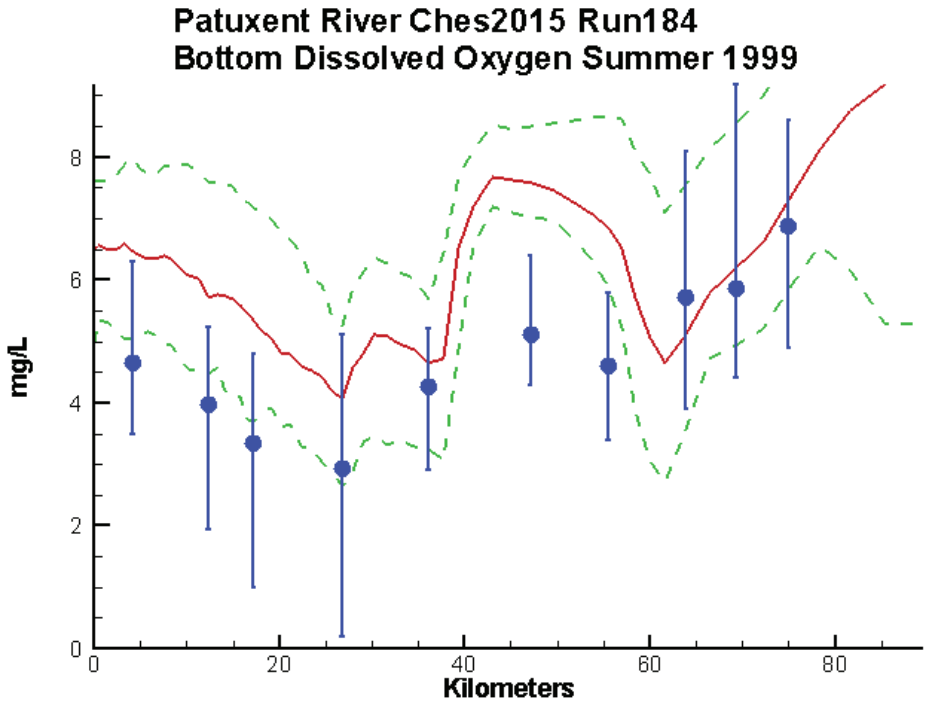


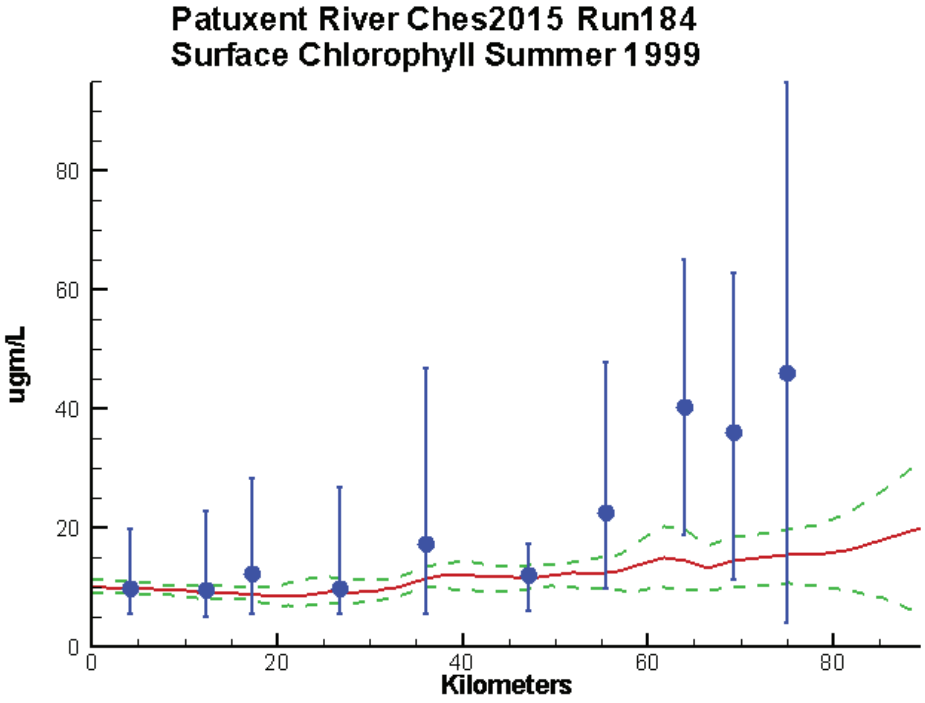


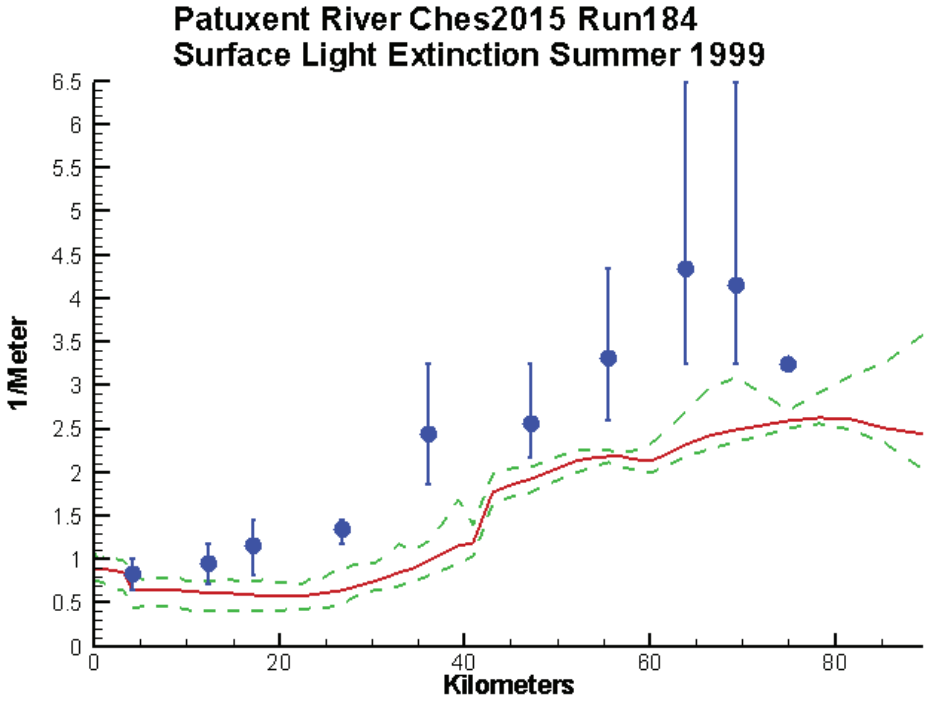


Patuxent River - Summer - 1999









Appendix D: Longitudinal Comparisons 2002-2011

The spatial distributions of observed and computed properties were compared in a series of plots along the axes of the bay and major tributaries (Figure 1). The calibration period encompassed more than 100 cruises. Reducing this number of surveys into a manageable volume of comparisons required selection and aggregation. Three years were selected for comparisons: 2004, 2007, and 2010. These years are not so readily characterized by flow as the earlier sequence. Susquehanna River flows for all three years fall between the 1999 (dry) and 2004 (average) flows of the earlier sequence.

Model results and observations were averaged into four seasons:

Winter - December through February
Spring - March through May
Summer - June through August
Fall - September through November

Conventional arithmetic means were calculated for the observations. Model results were subjected to a process denoted as "cruise averaging." Within each season, model results were considered only during intervals coinciding with sample cruises. Cruise averaging diminished discrepancies between model and observations attributed to consideration of model results for periods when no data was collected. Daily averages of model results were computed within the model code. Cruise averaging was completed in a postprocessor. Arithmetic averages of modeled substance were computed during cruise periods except for light attenuation and total suspended solids. The variance of the computed values skewed arithmetic means to unrepresentative high values. For these two components, log averages were calculated. The postprocessor also extracted the maximum and minimum computed daily averages.

The mean and range of the observations, at surface and bottom, were compared to the cruise average and range of daily-average model results. The longitudinal axes largely followed the maximum depths represented on the model grid. Only stations located exactly on the transect were considered for comparison with the model. Comparisons were made for physical quantities (salinity, temperature, suspended solids, light attenuation), chlorophyll, dissolved oxygen, and multiple forms of carbon, nitrogen, and phosphorus.

We concentrate here on the components which correspond closely to chlorophyll, clarity, and dissolved oxygen in the critical summer period. Dissolved oxygen is shown at the surface and bottom. Surface samples are from the 1 m depth. Bottom samples are typically 1 m off the bottom and follow local bathymetry. Model values are from surface and bottom cells on the grid. Chlorophyll and light attenuation are presented for the surface only. For all substances, the blue circles and vertical bars indicate mean and range of the observations. The continuous red and green traces represent model mean and range, subject to the selection and averaging process described above.

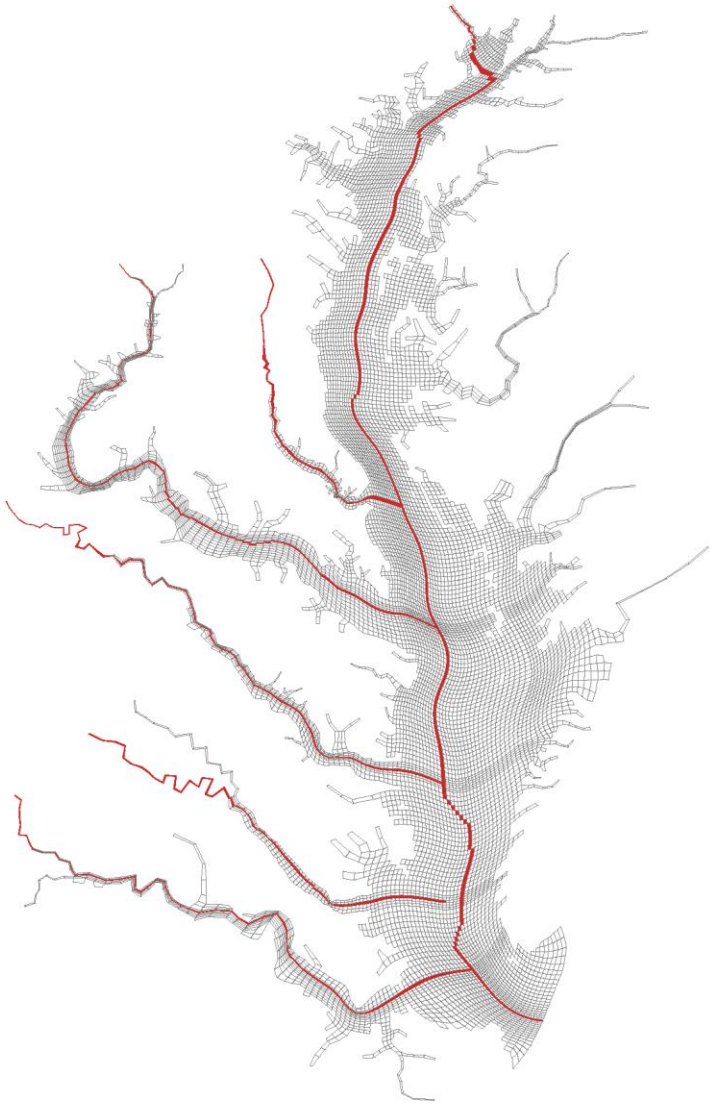
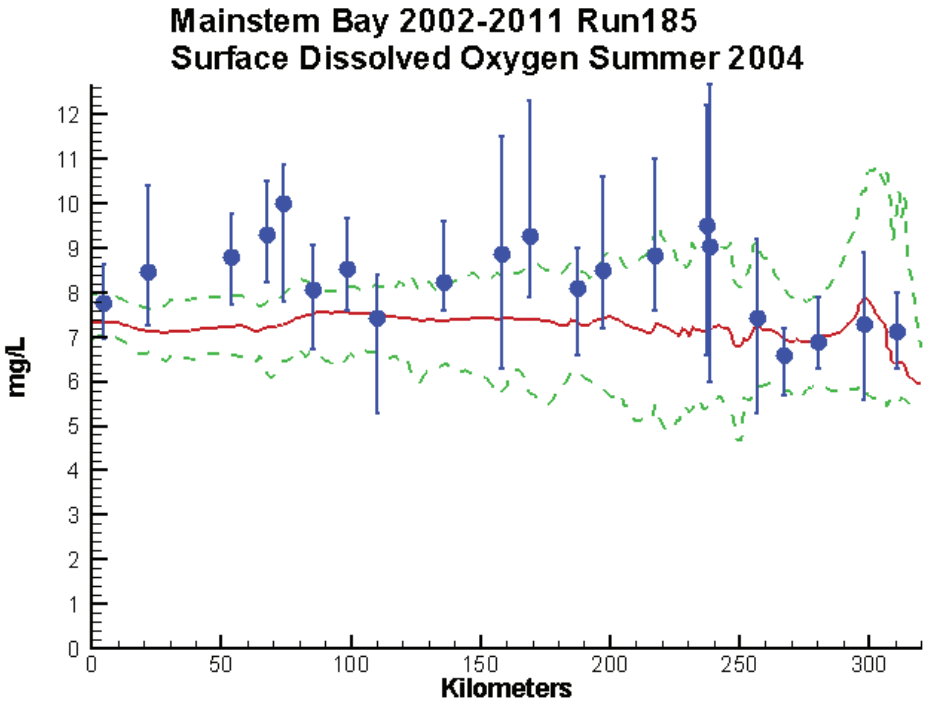
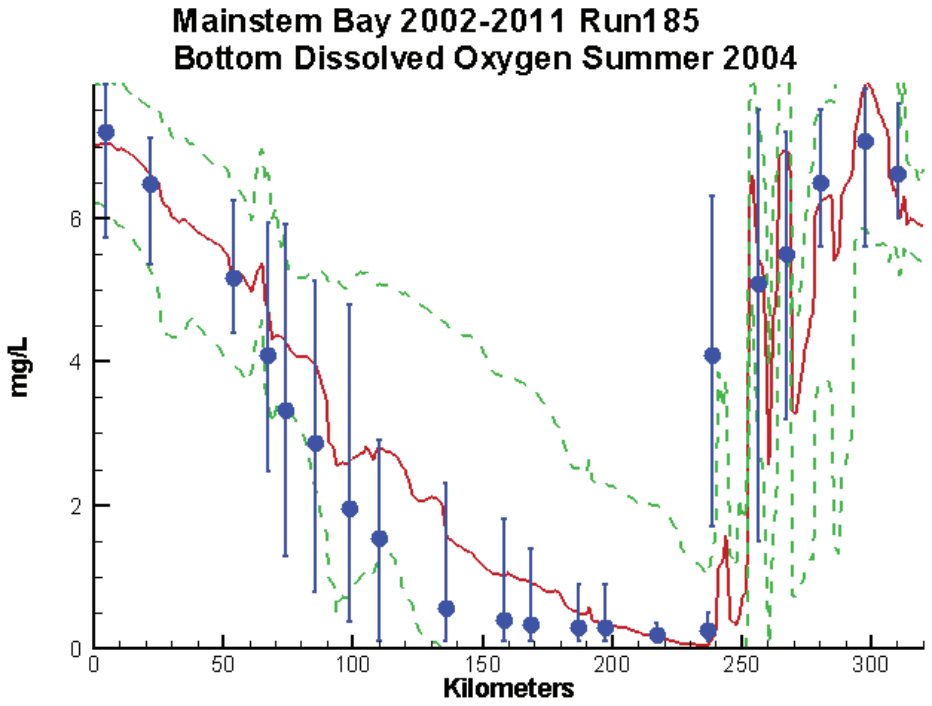
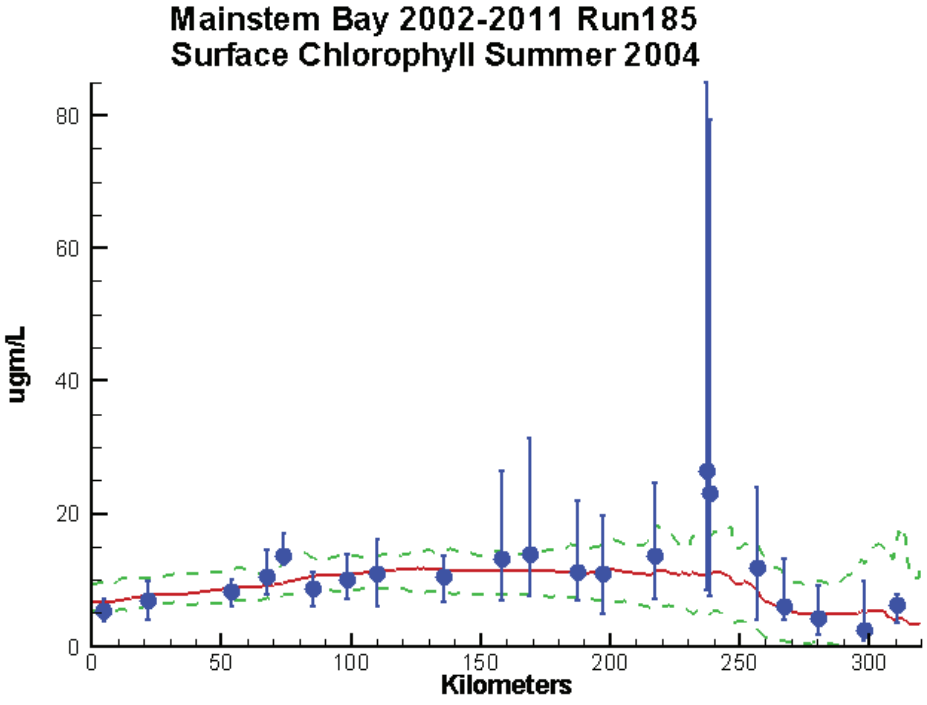


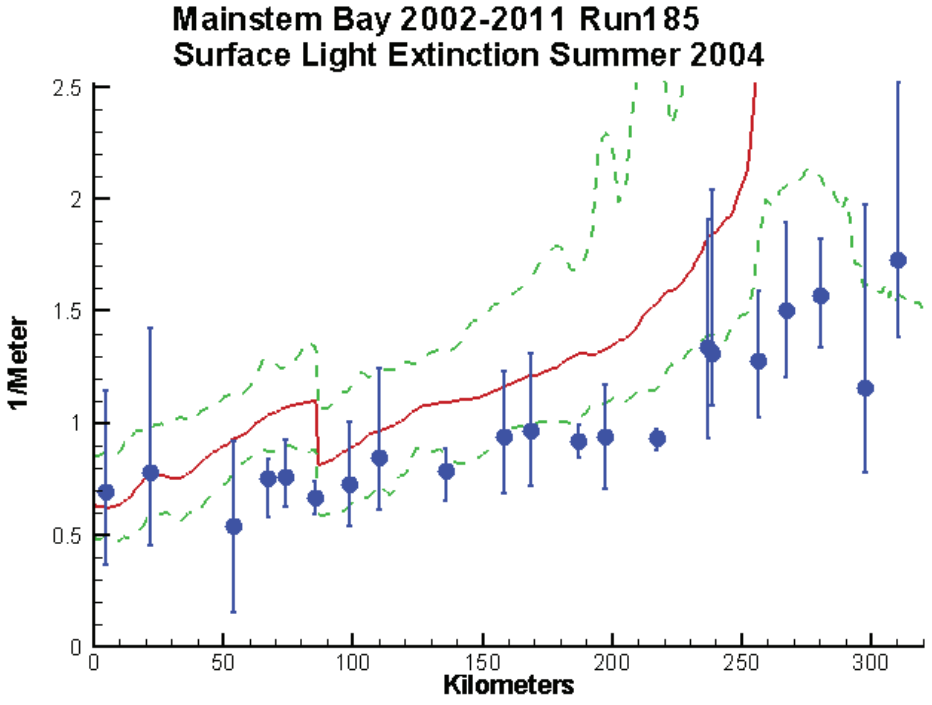
Figure 1. Longitudinal transects in the bay and major tributaries.

Mainstem Bay - Summer - 2004

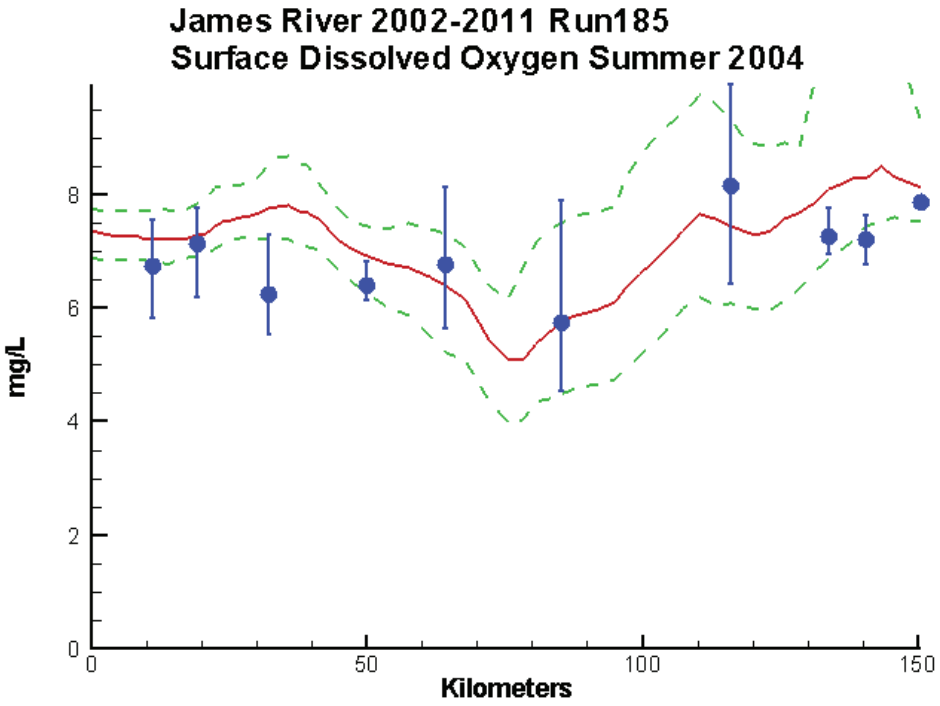


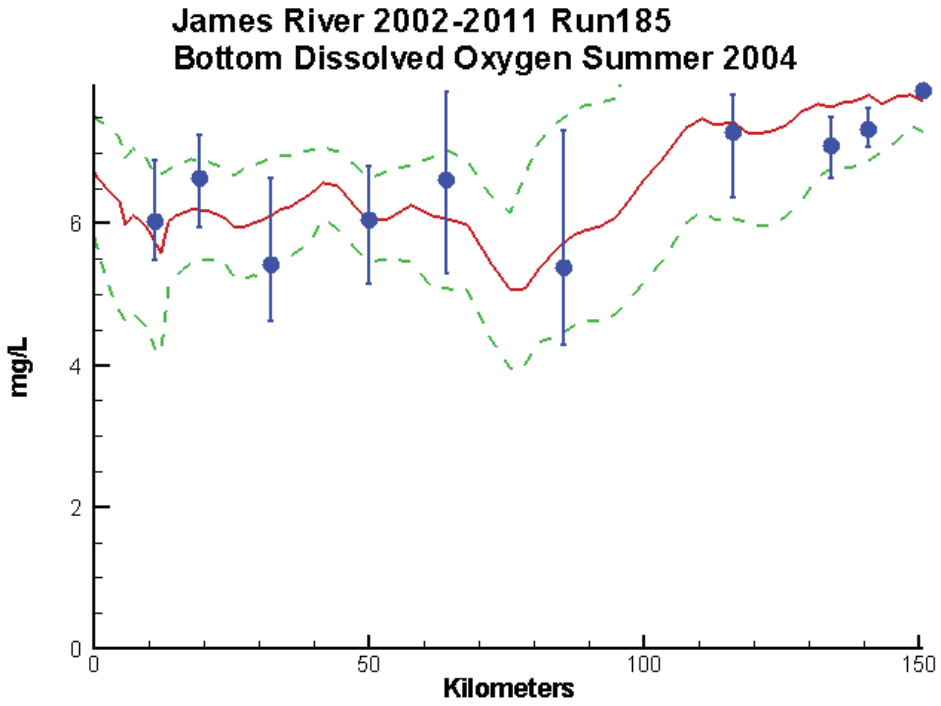


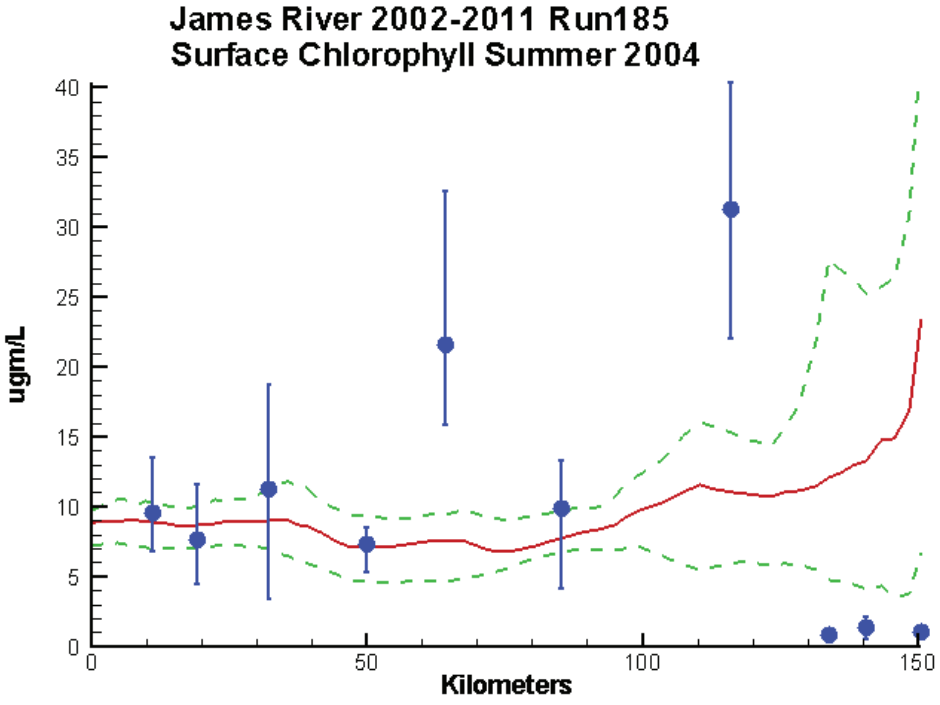


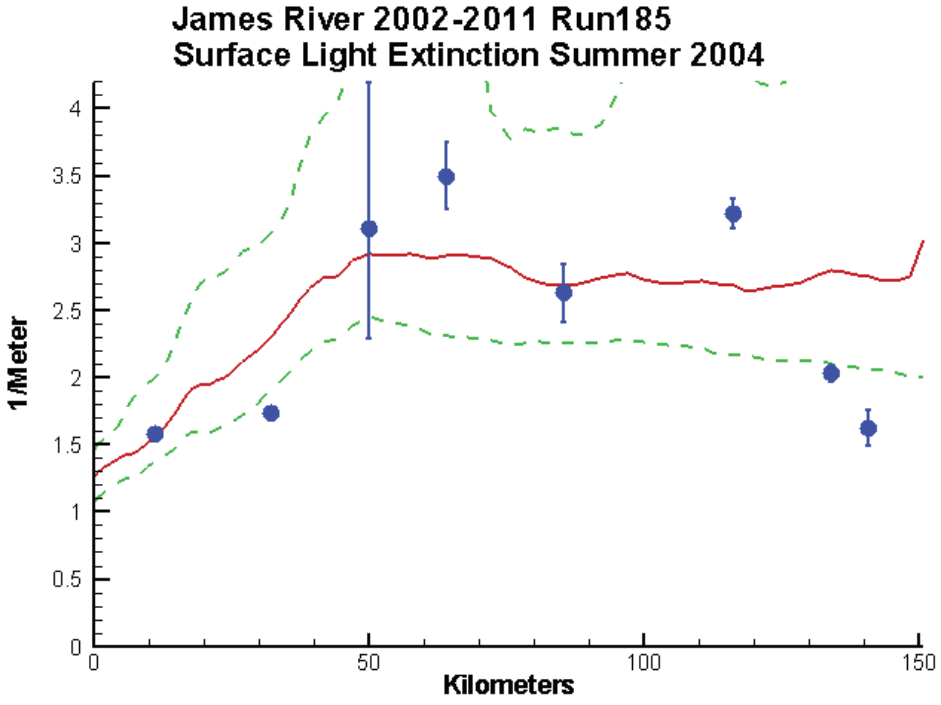


James River - Summer - 2004

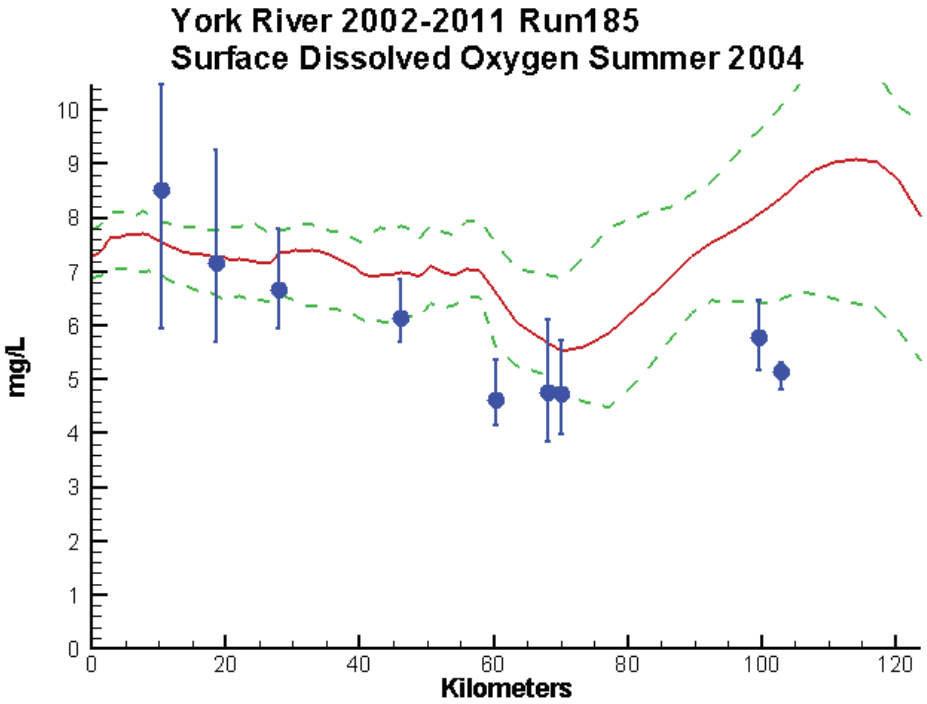


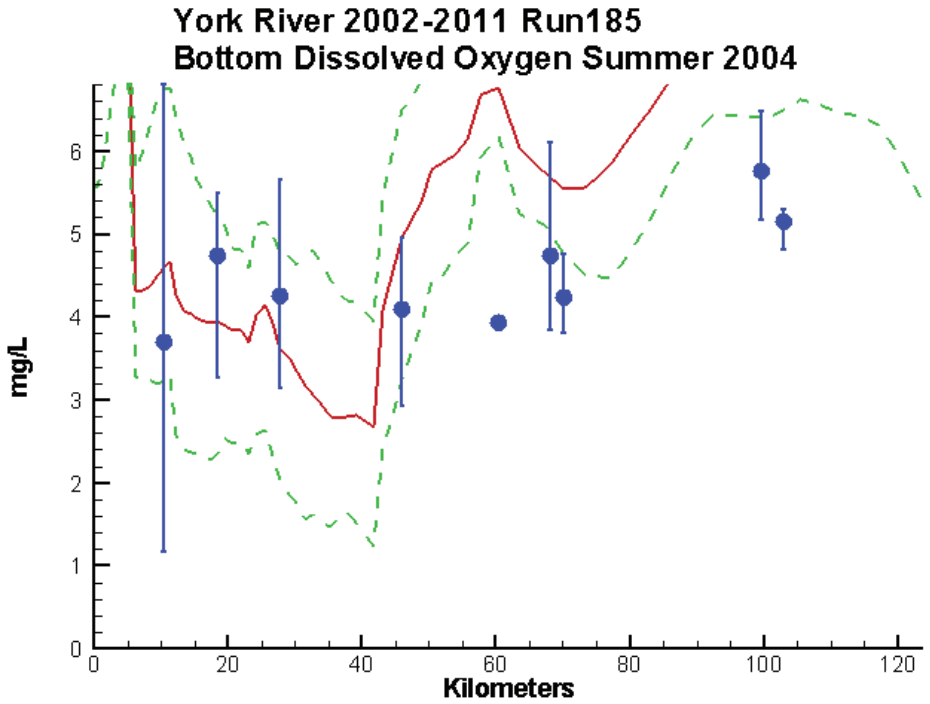


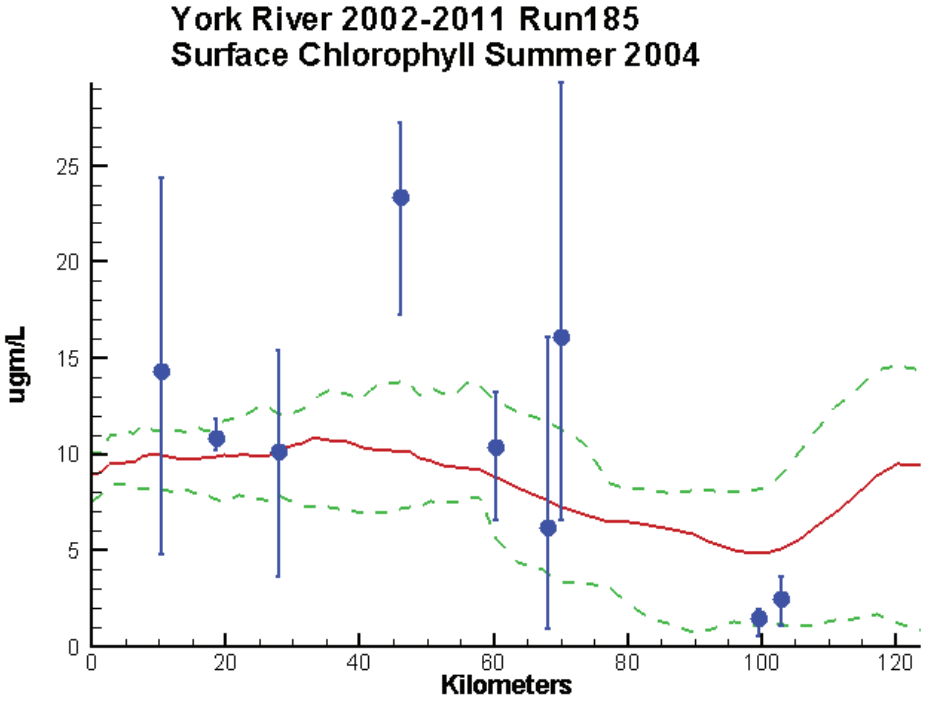


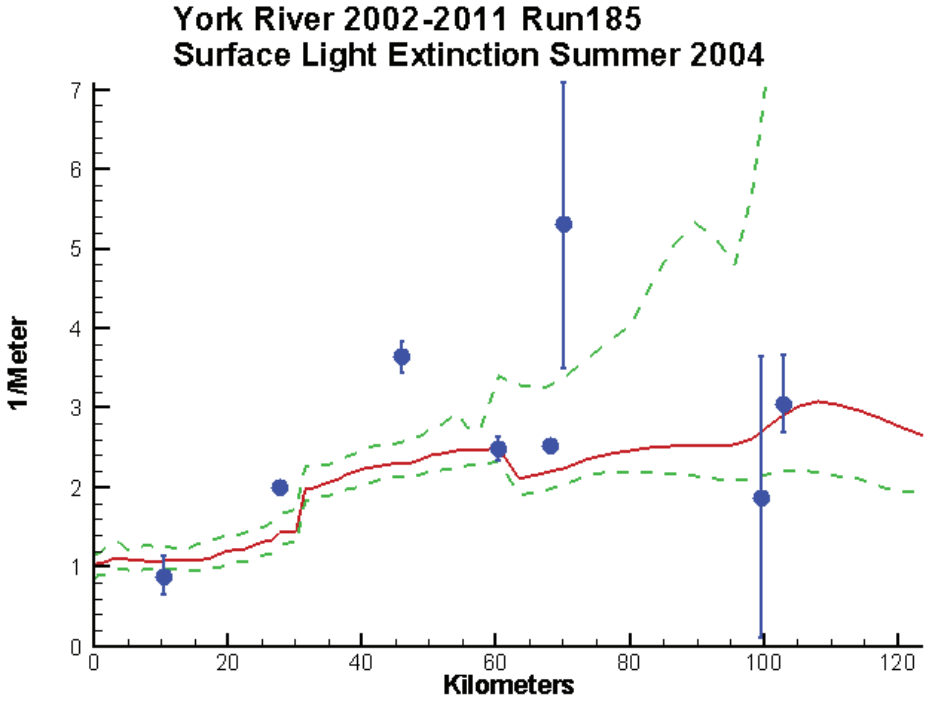


York River - Summer - 2004

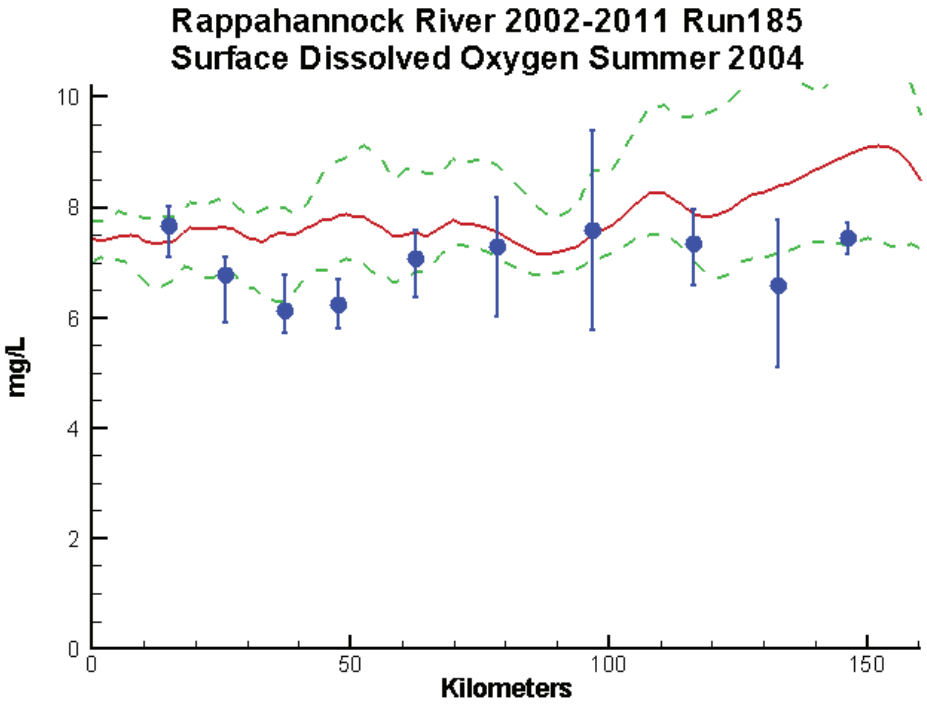


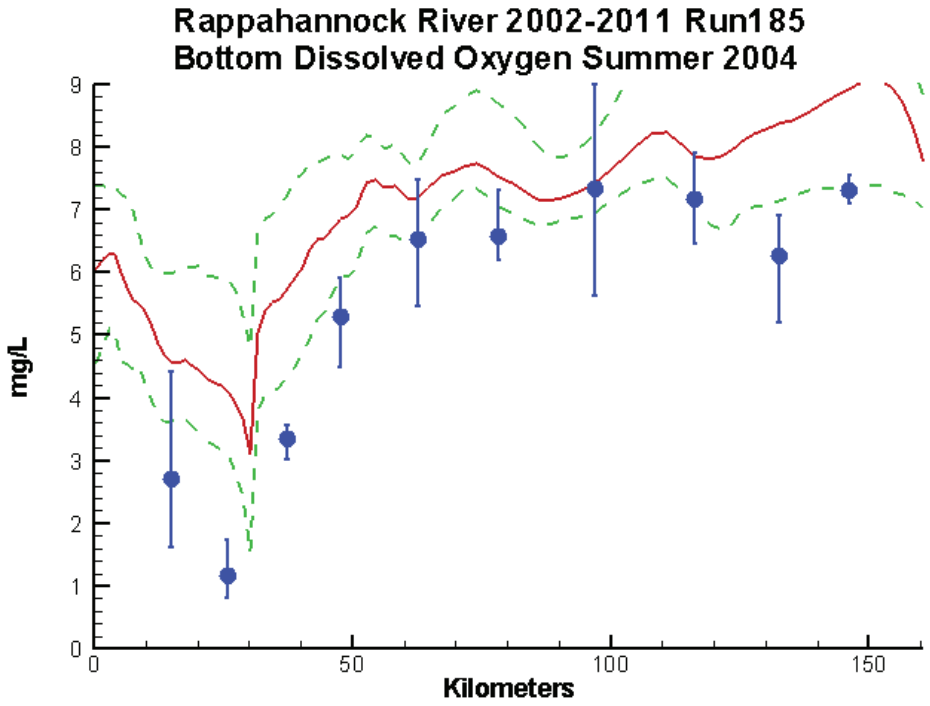


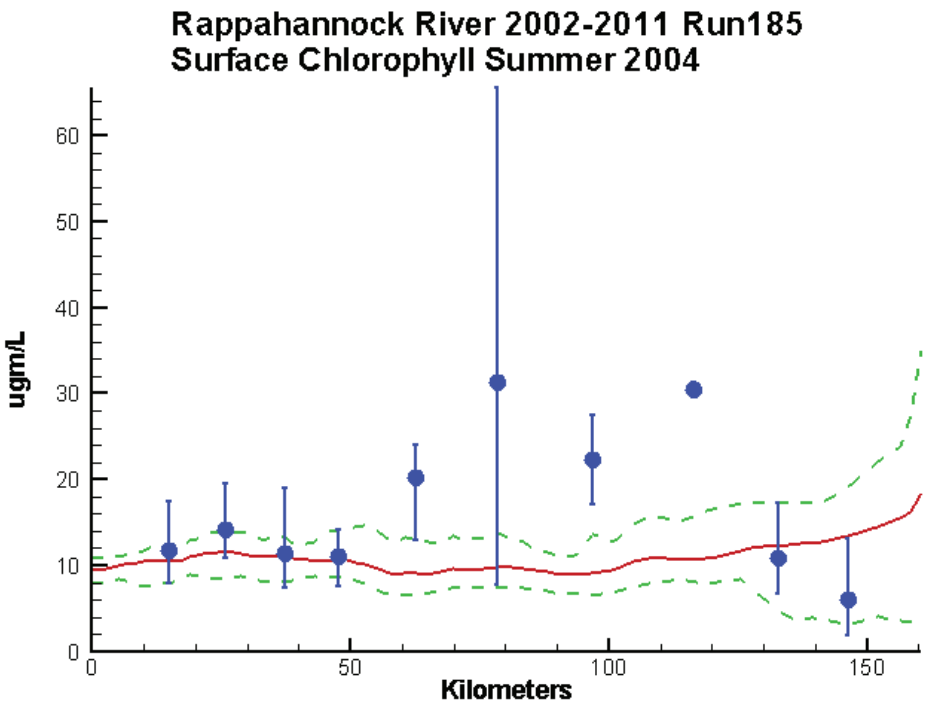


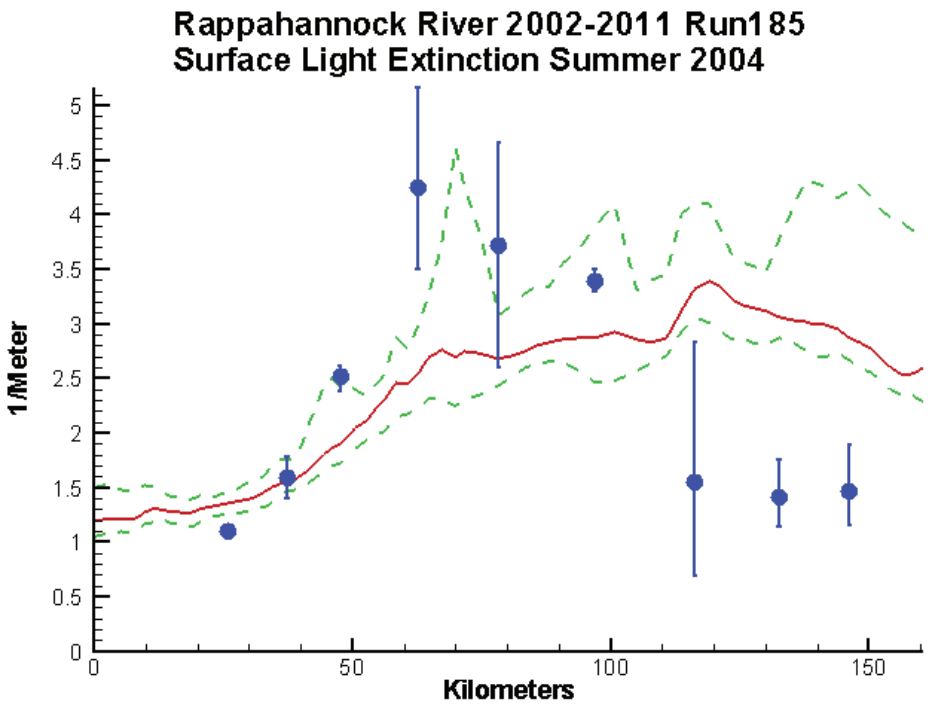


Rappahannock River - Summer - 2004

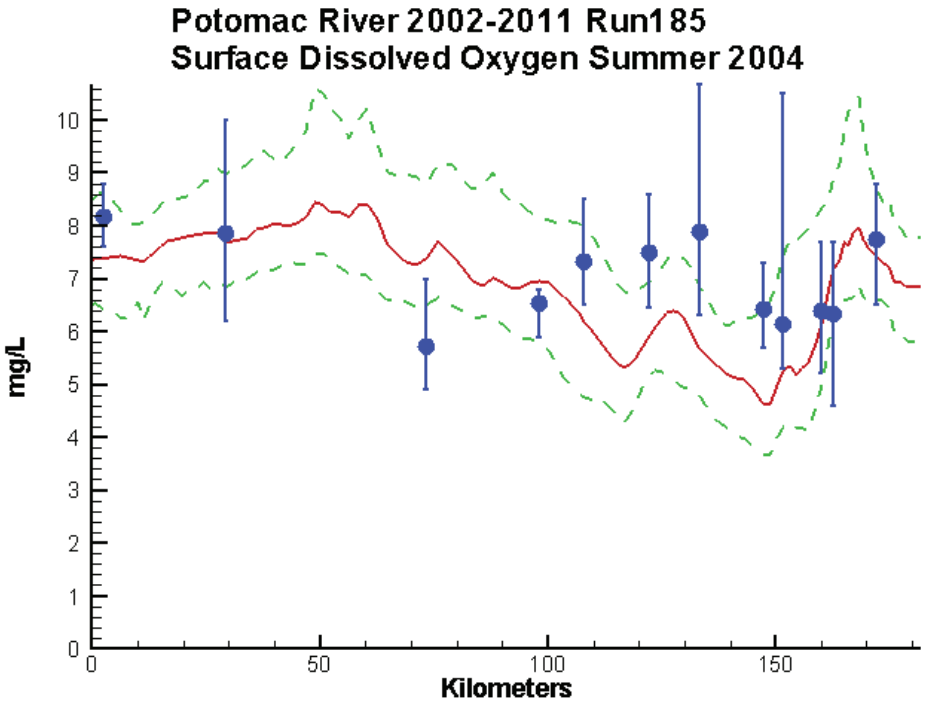


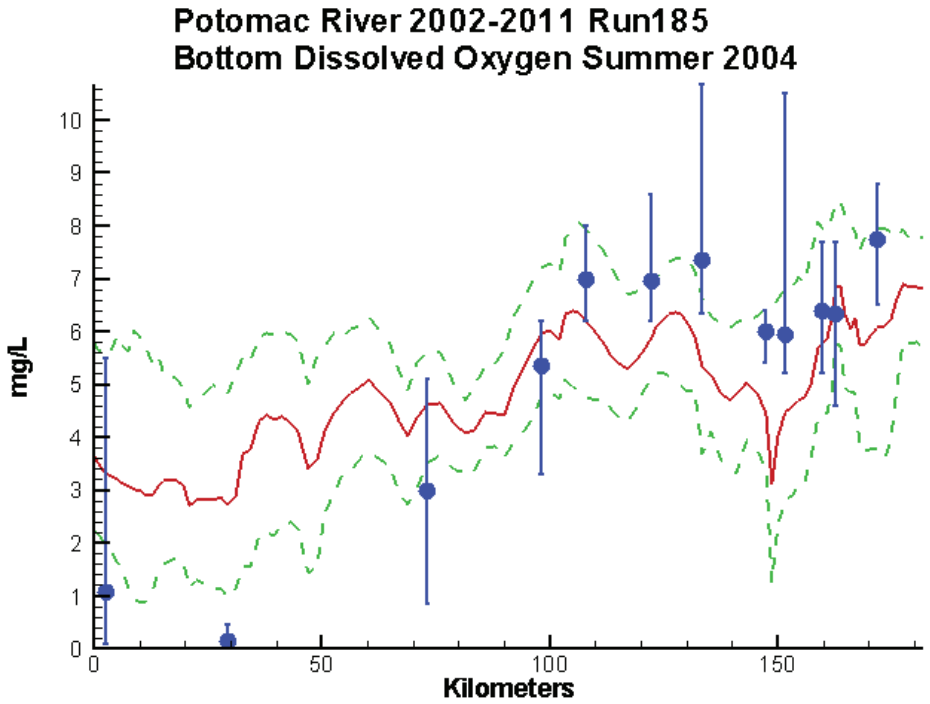


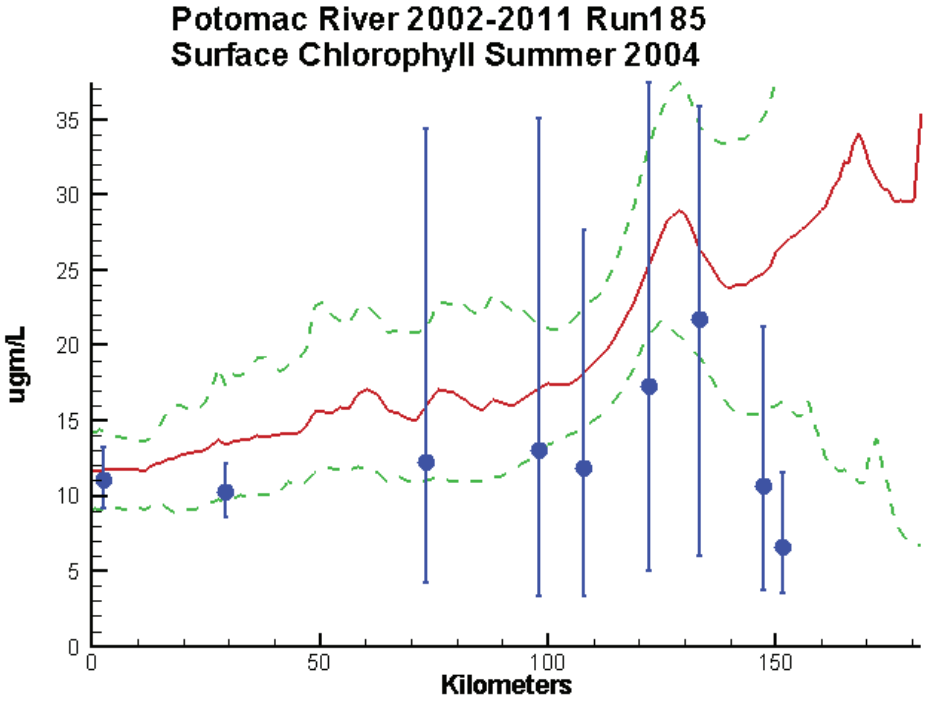


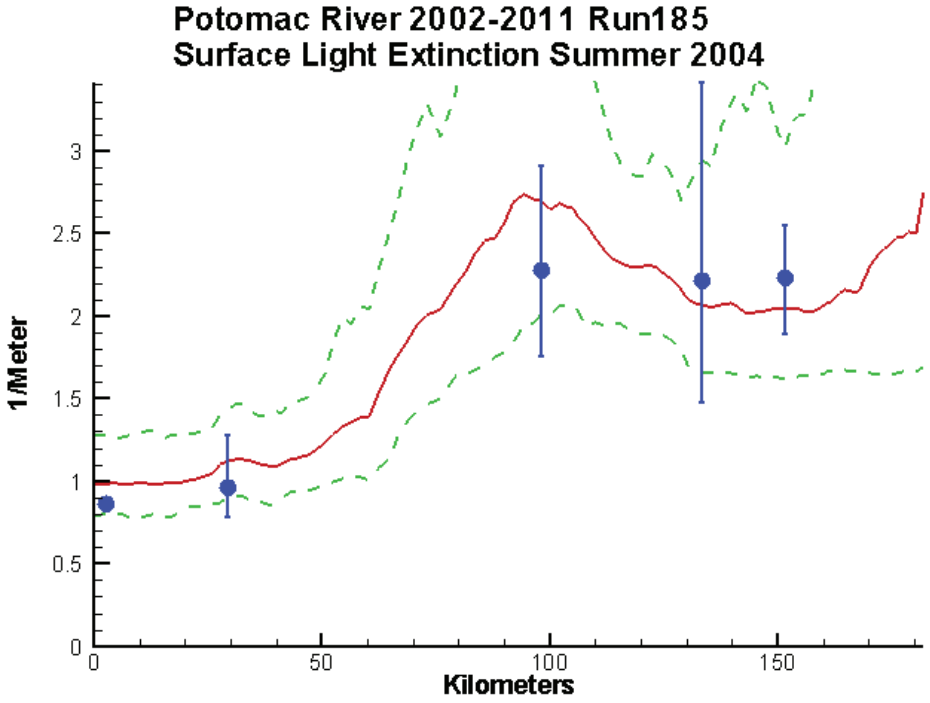


Potomac River - Summer - 2004

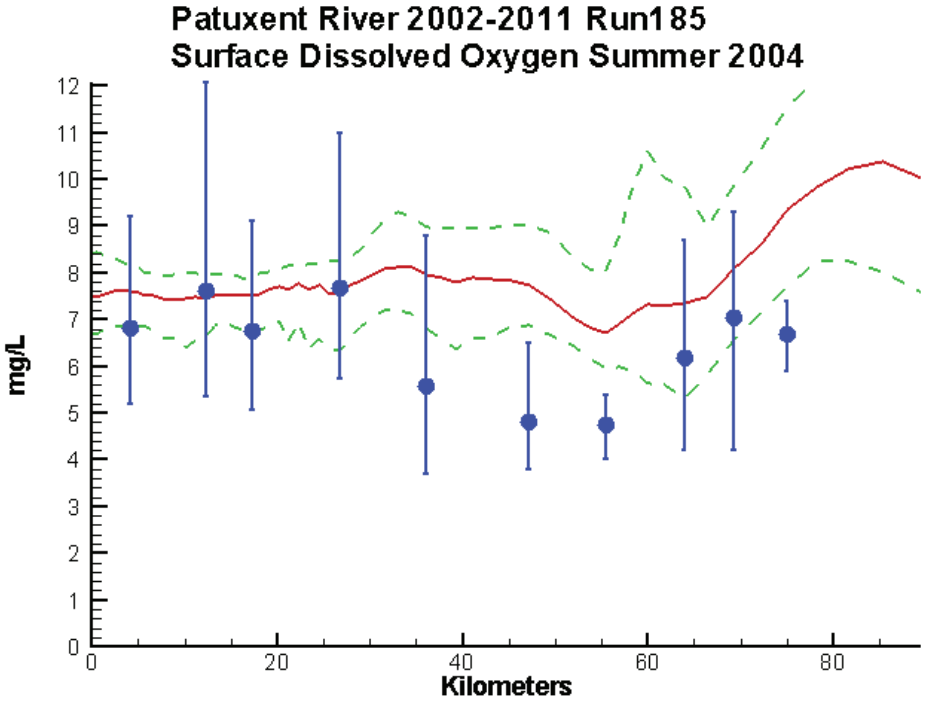


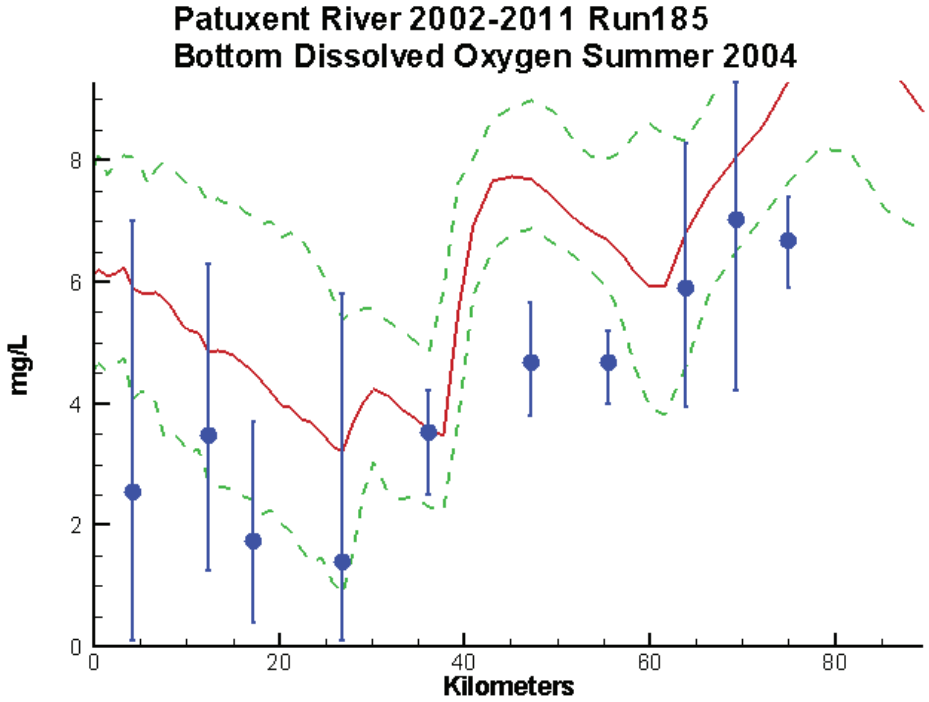


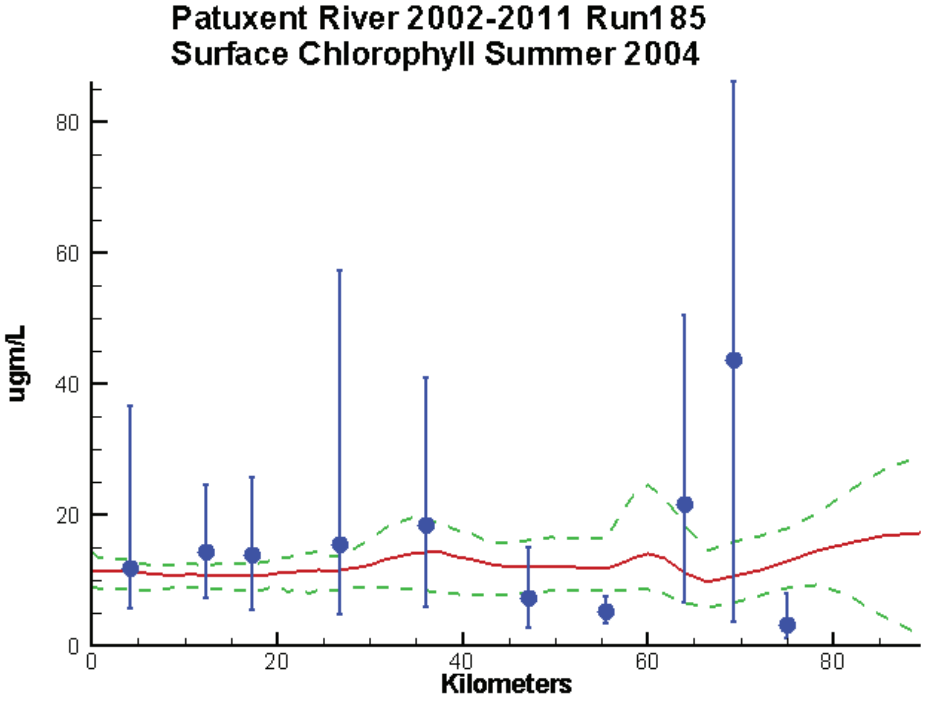


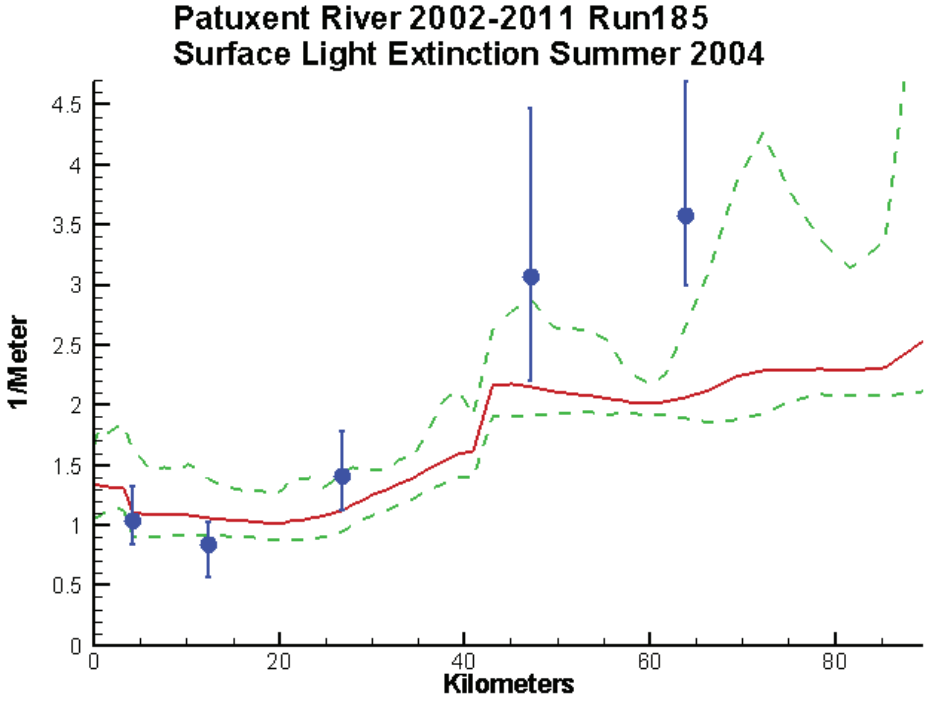


Patuxent River - Summer - 2004

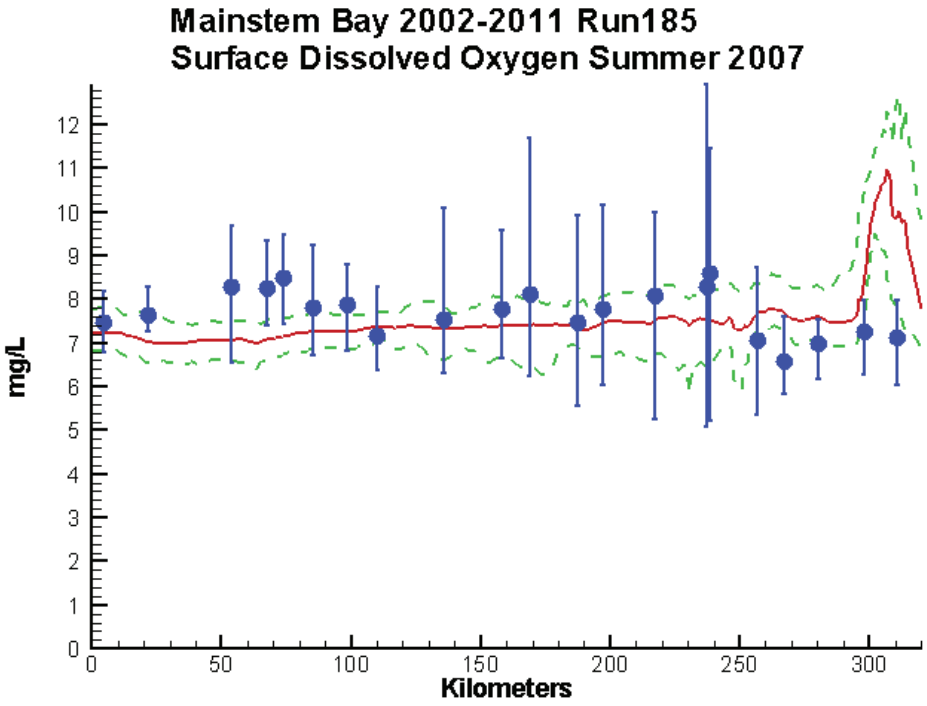


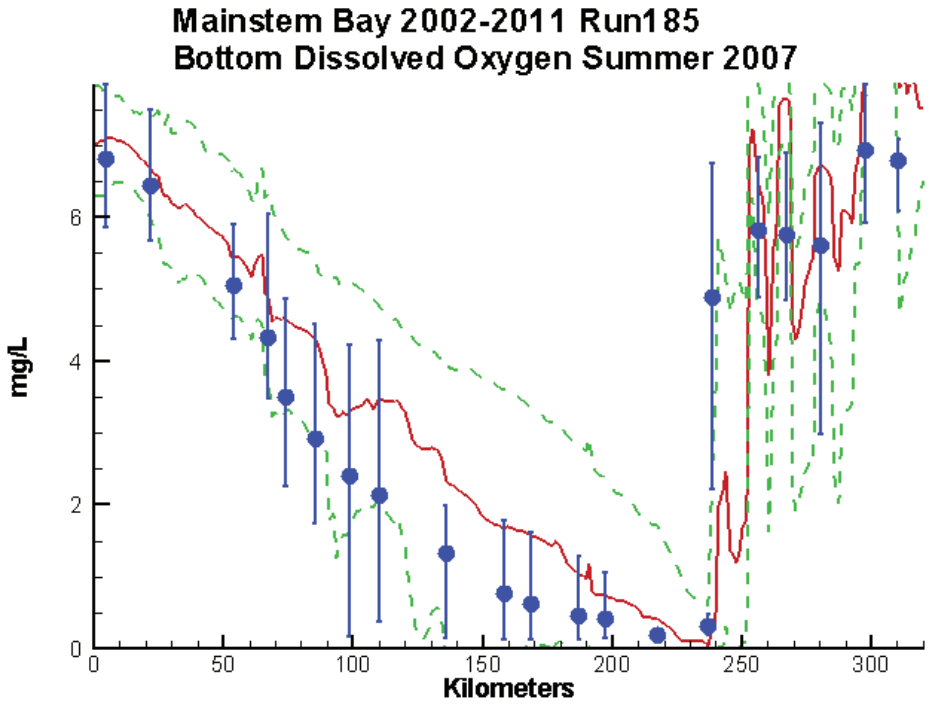


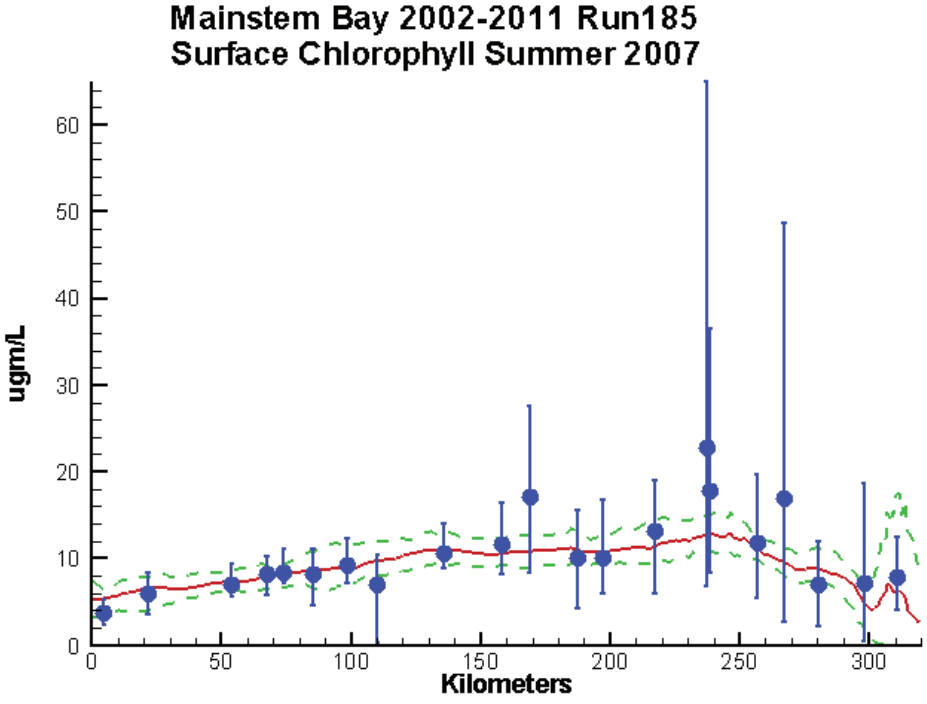


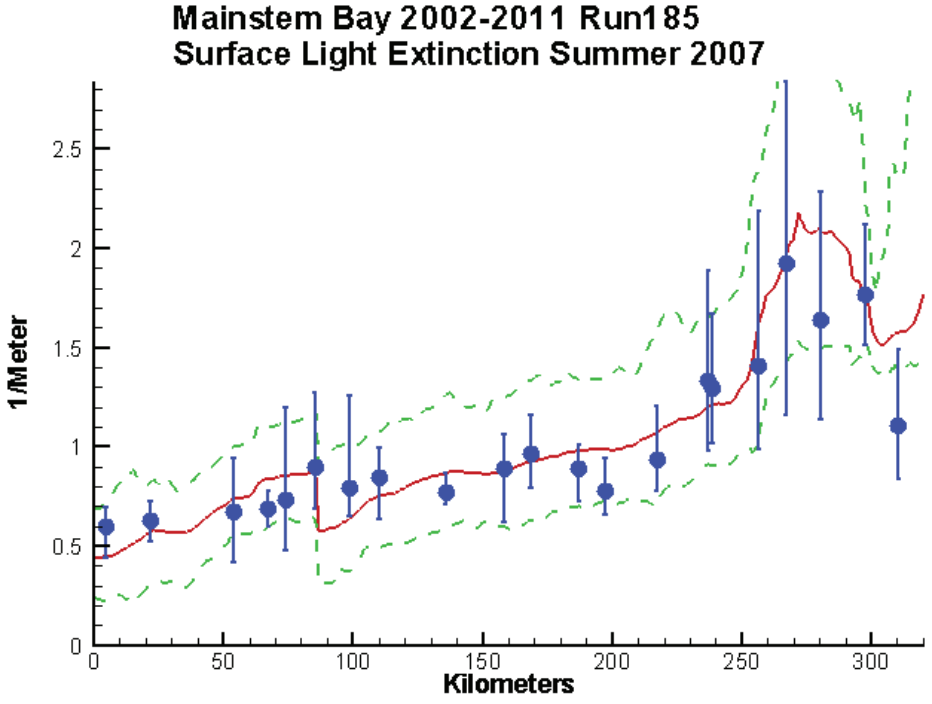


Mainstem Bay - Summer - 2007

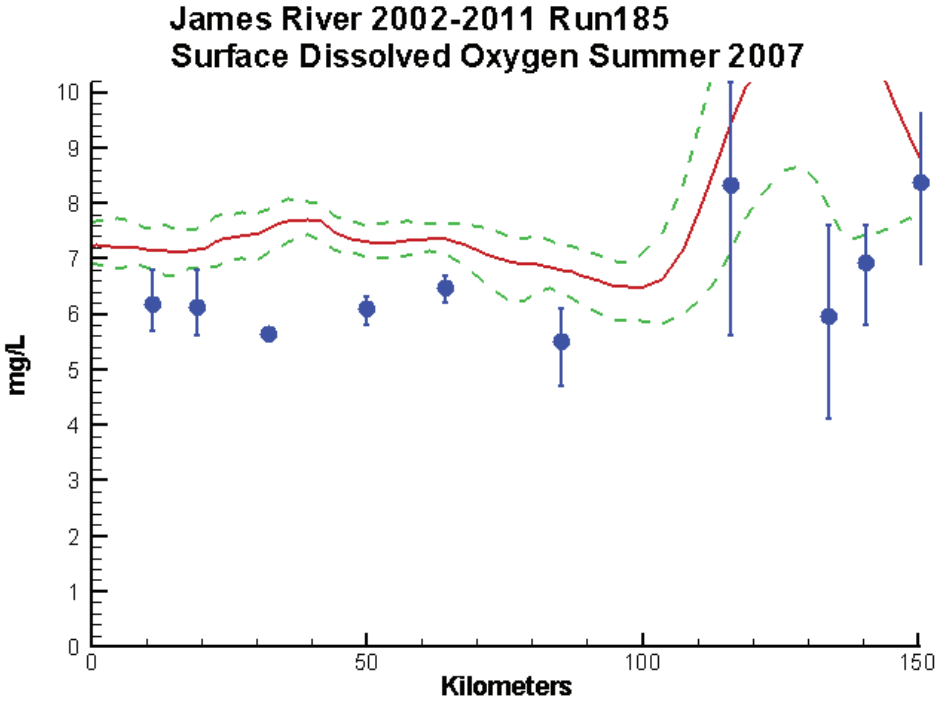


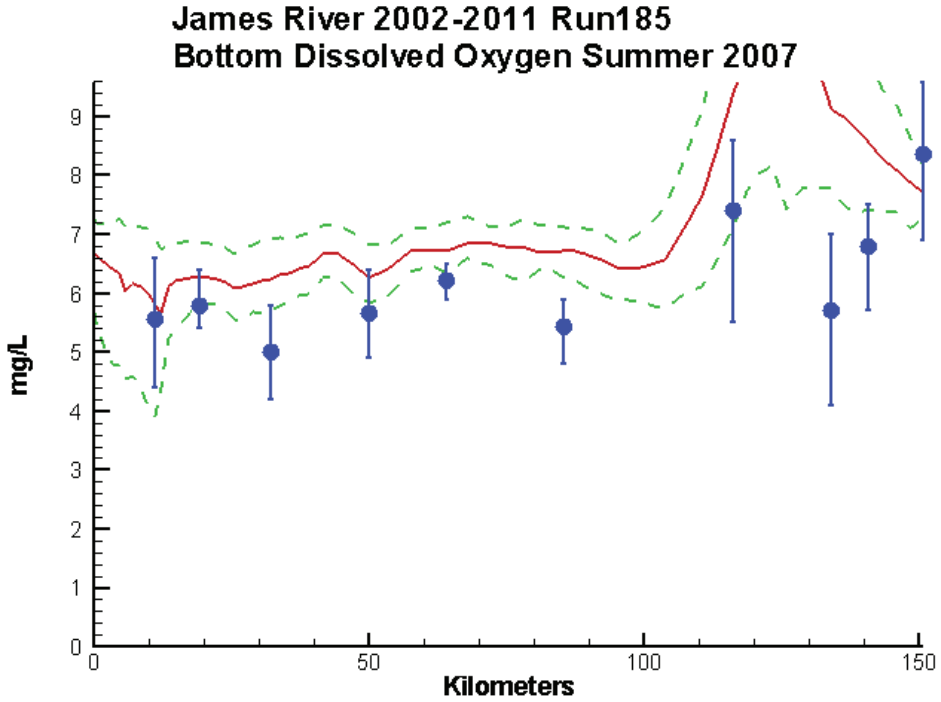


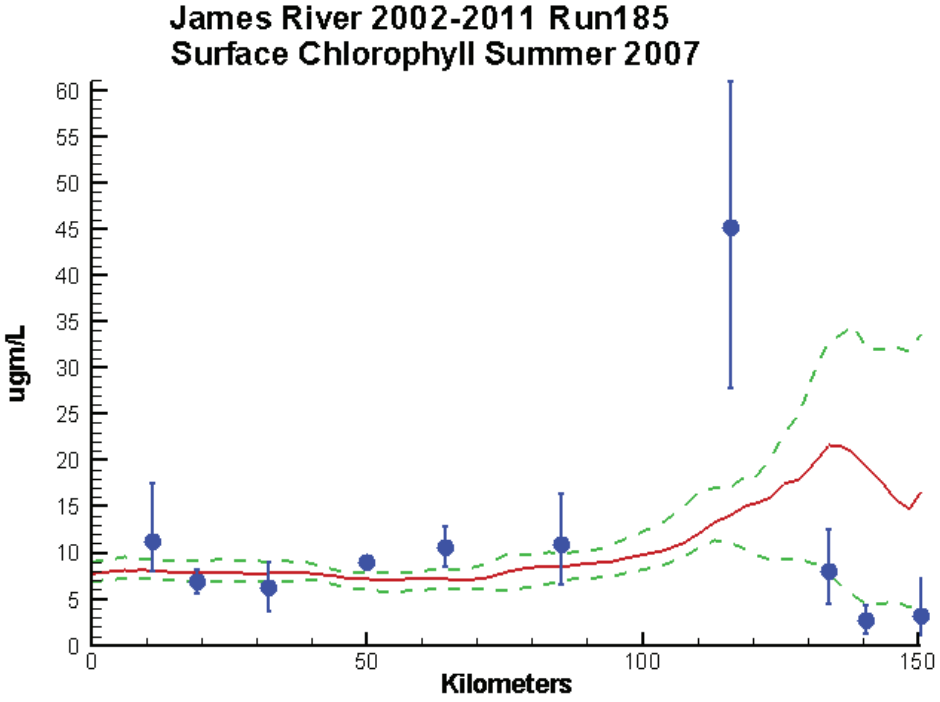


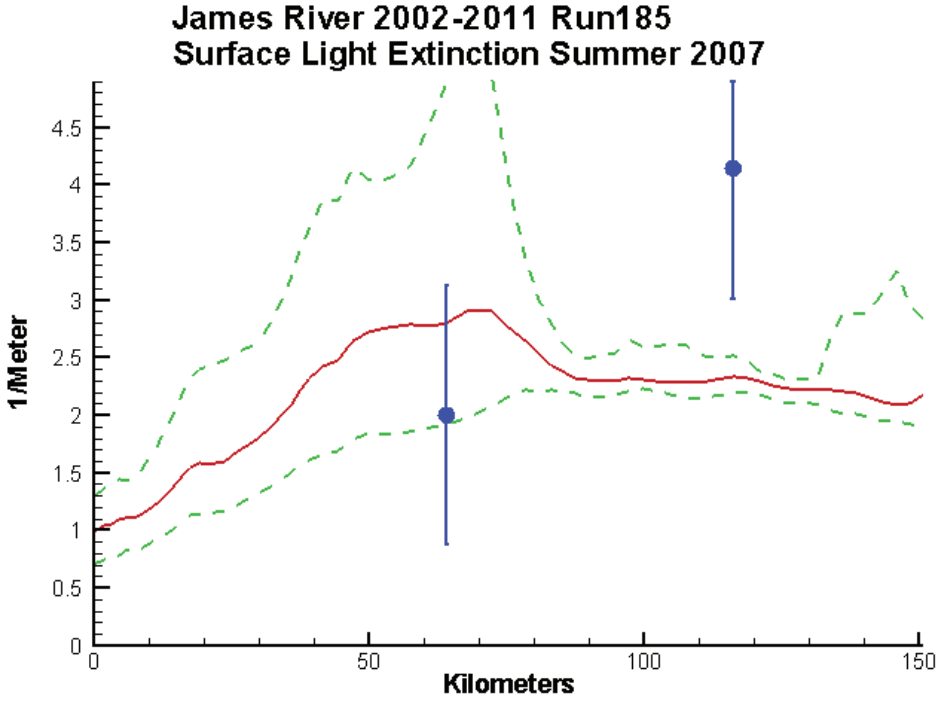


James River - Summer - 2007

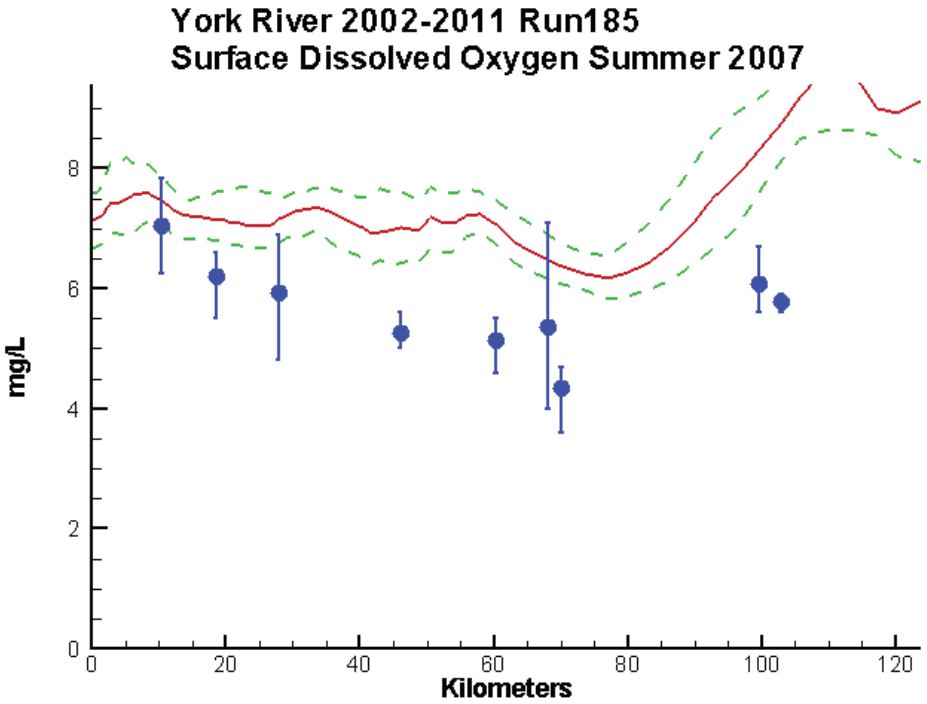


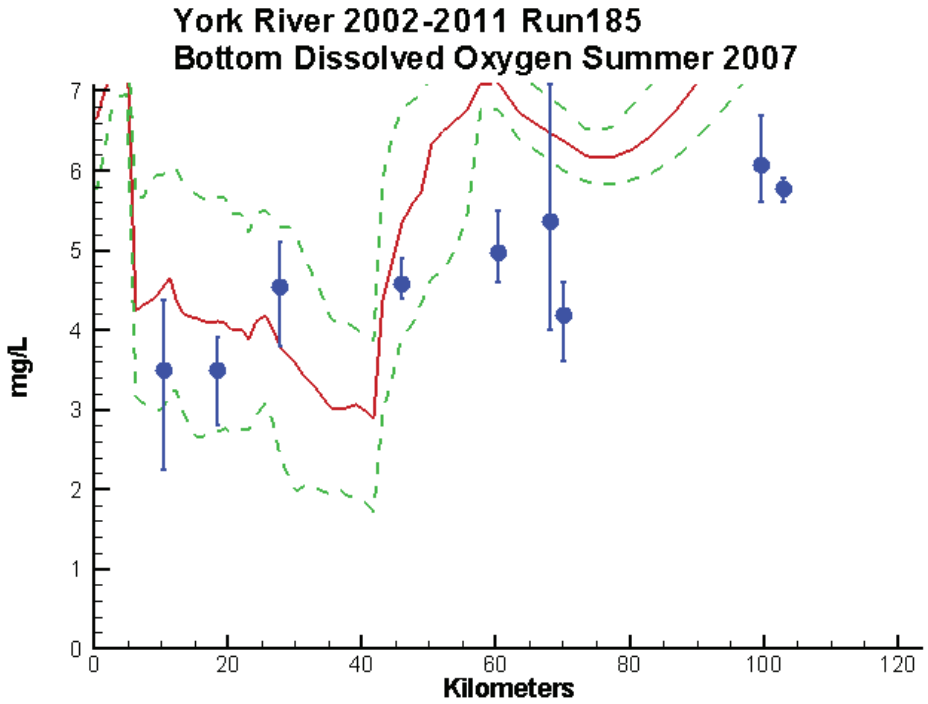


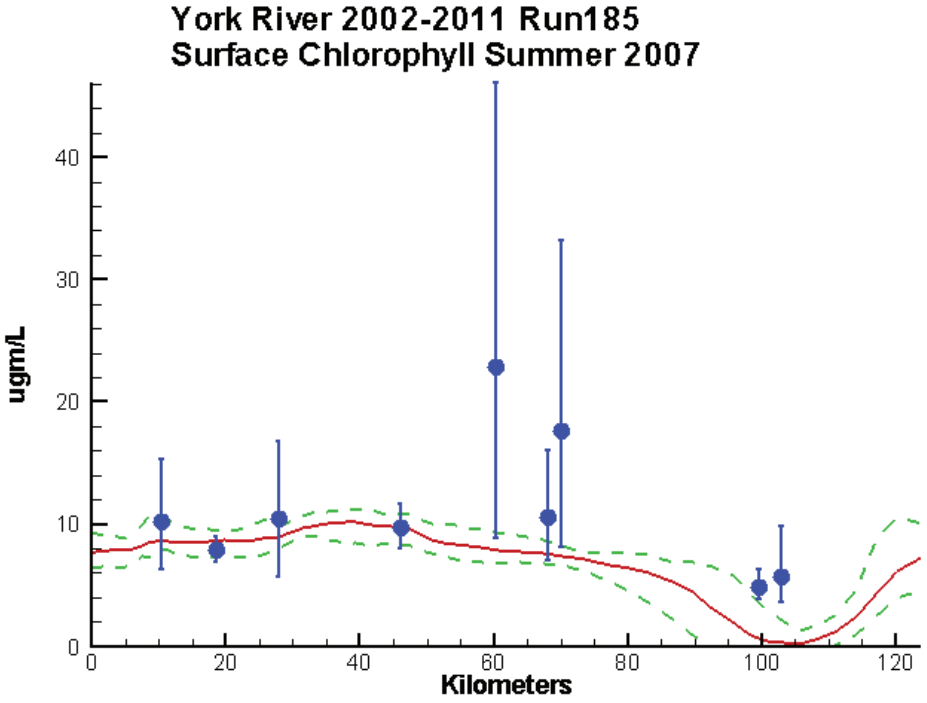


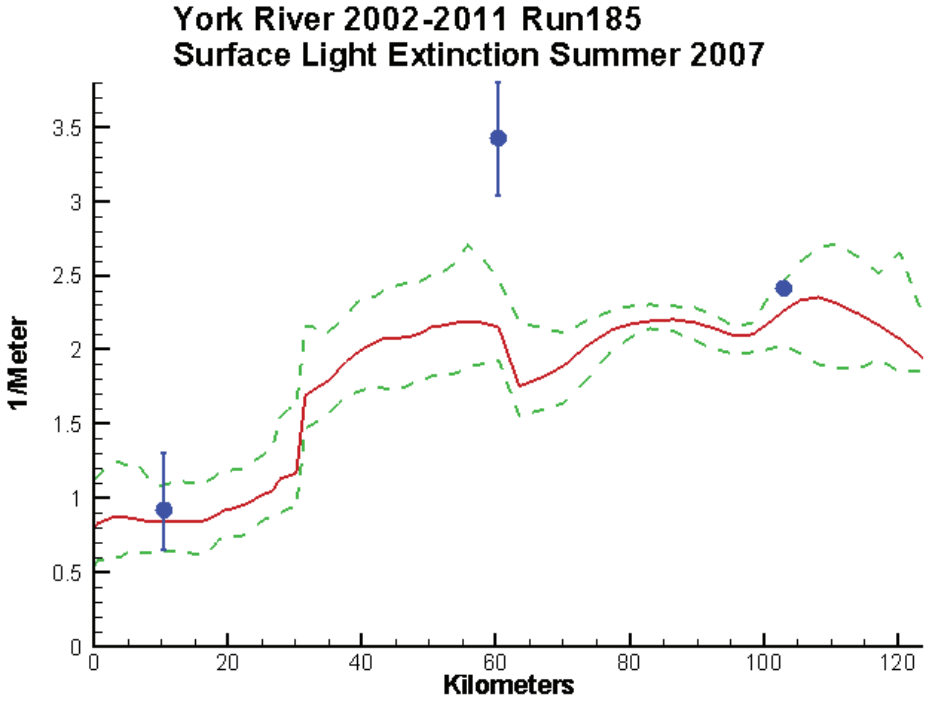


York River - Summer - 2007

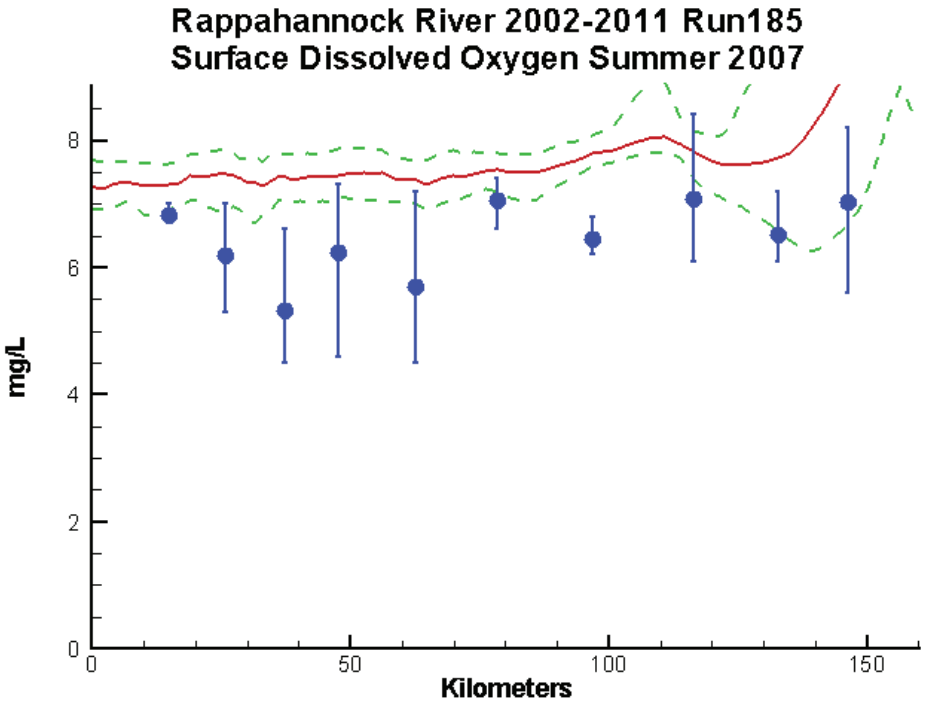


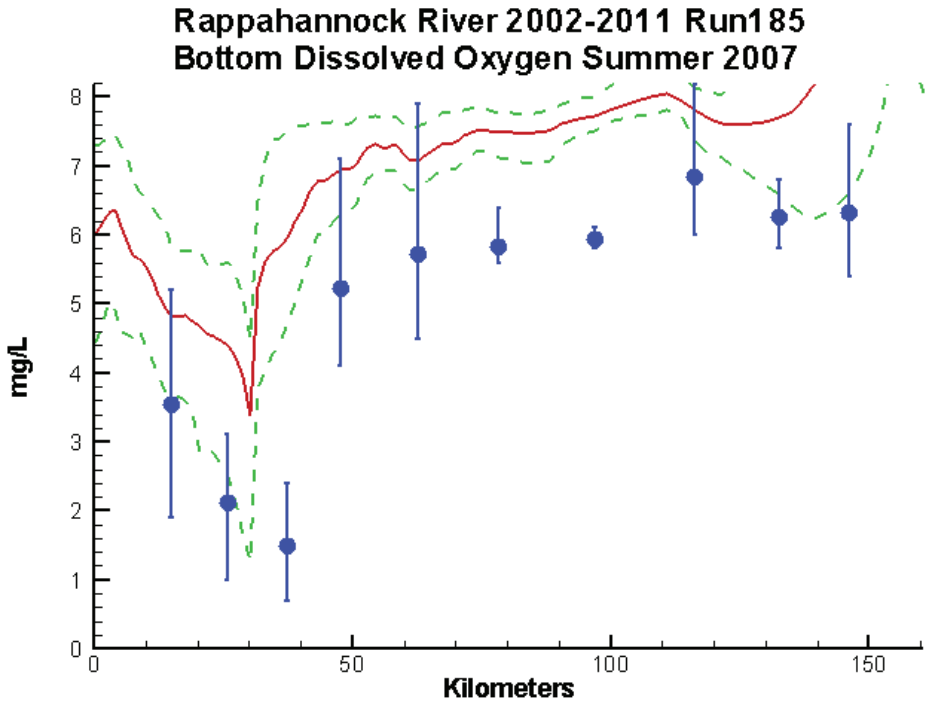


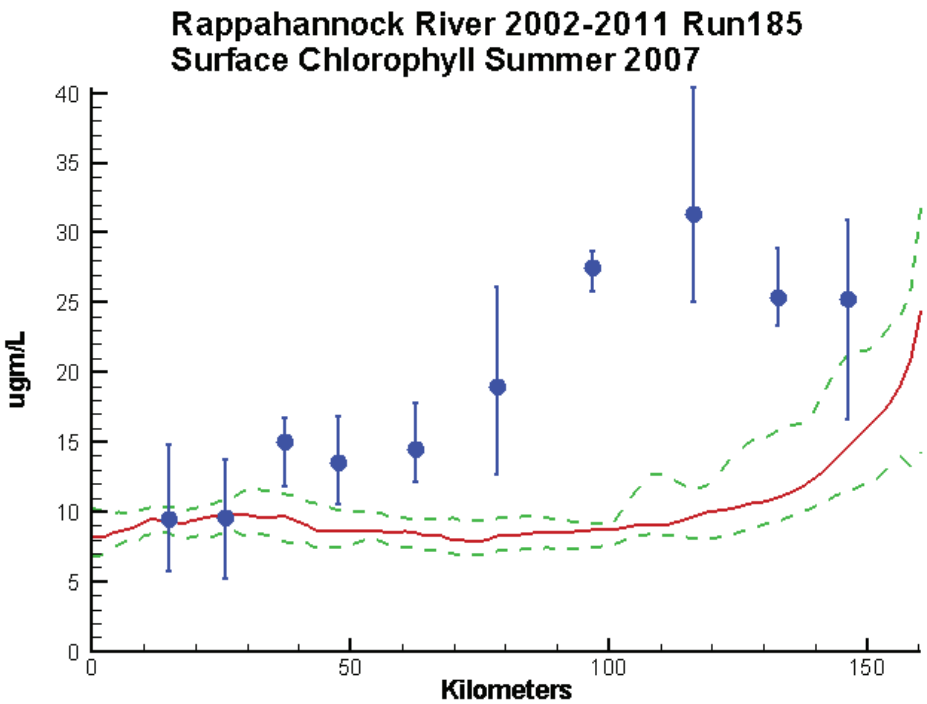


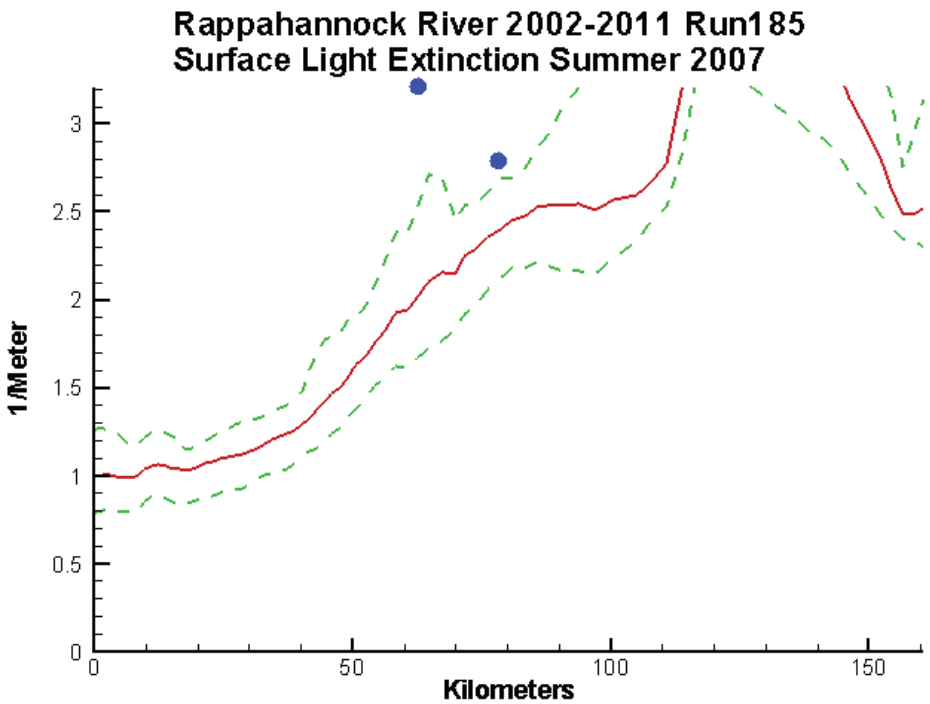


Rappahannock River - Summer - 2007

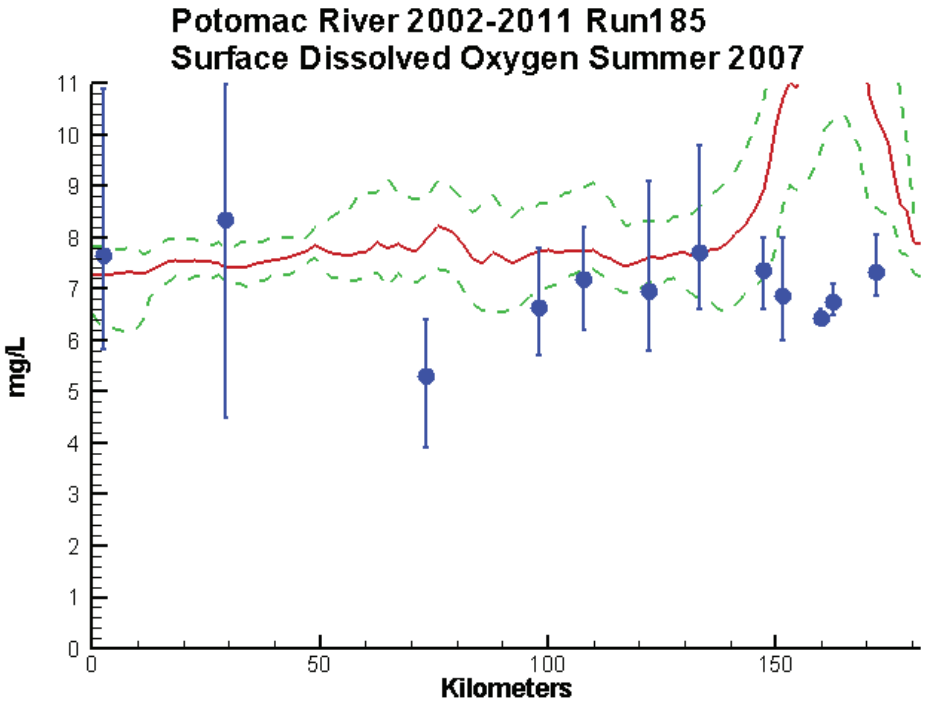


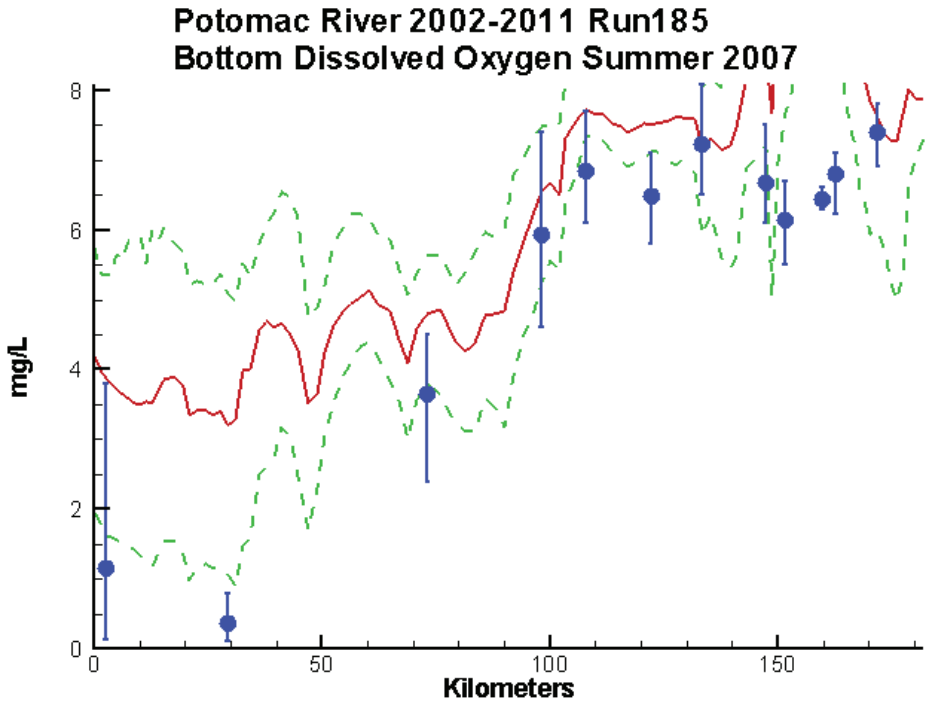


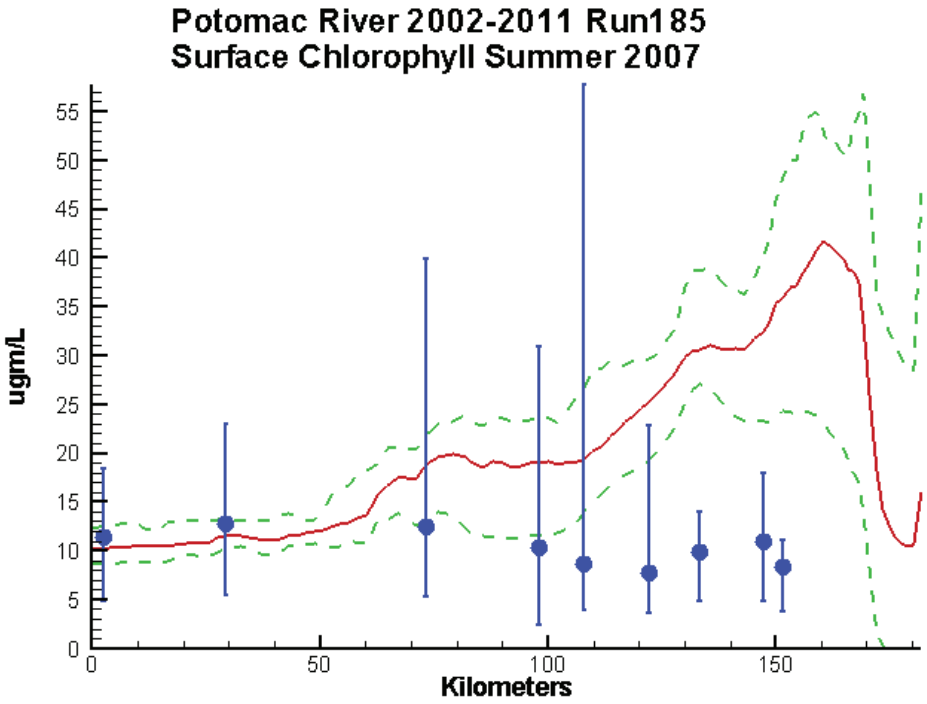


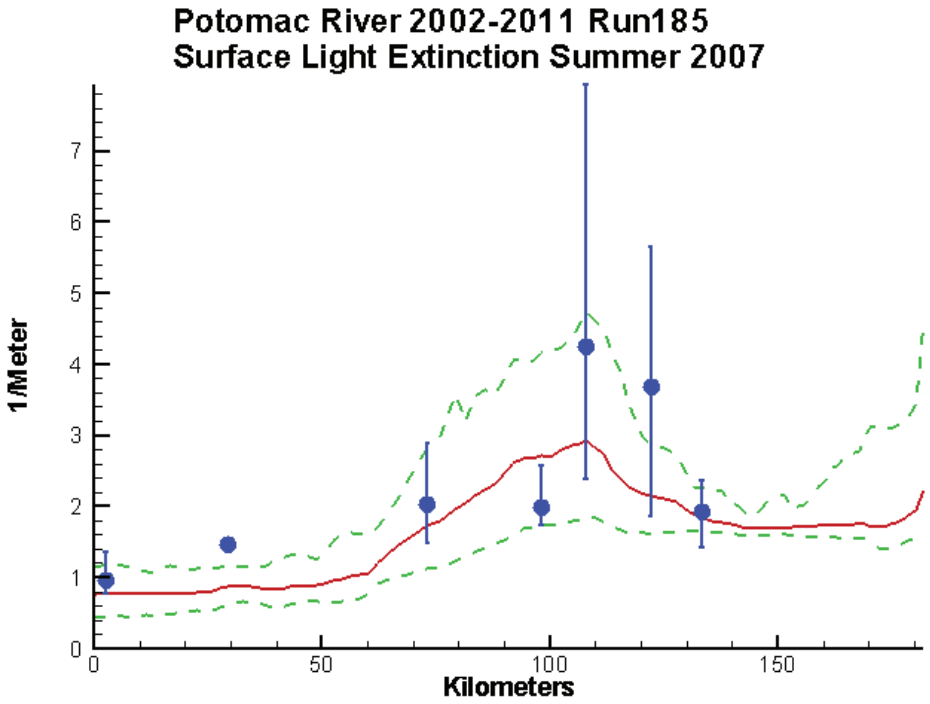


Potomac River - Summer - 2007

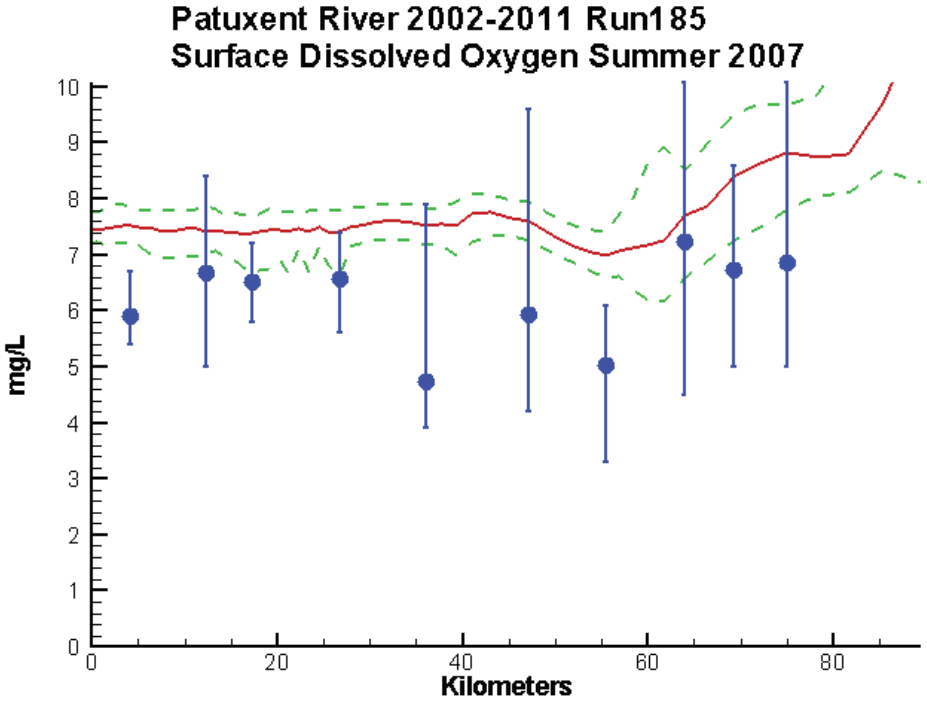


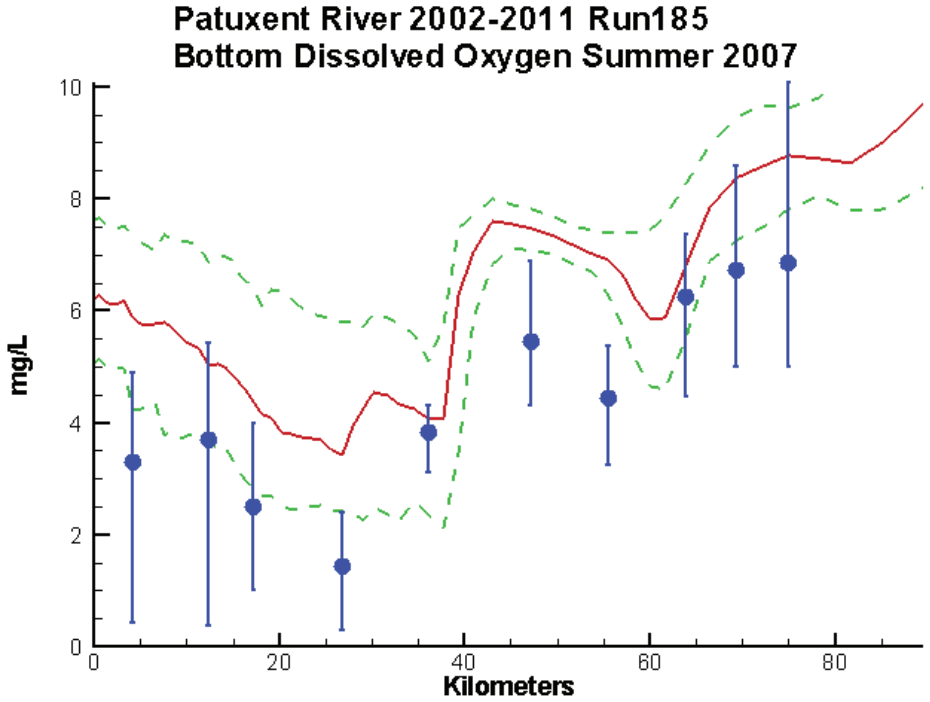


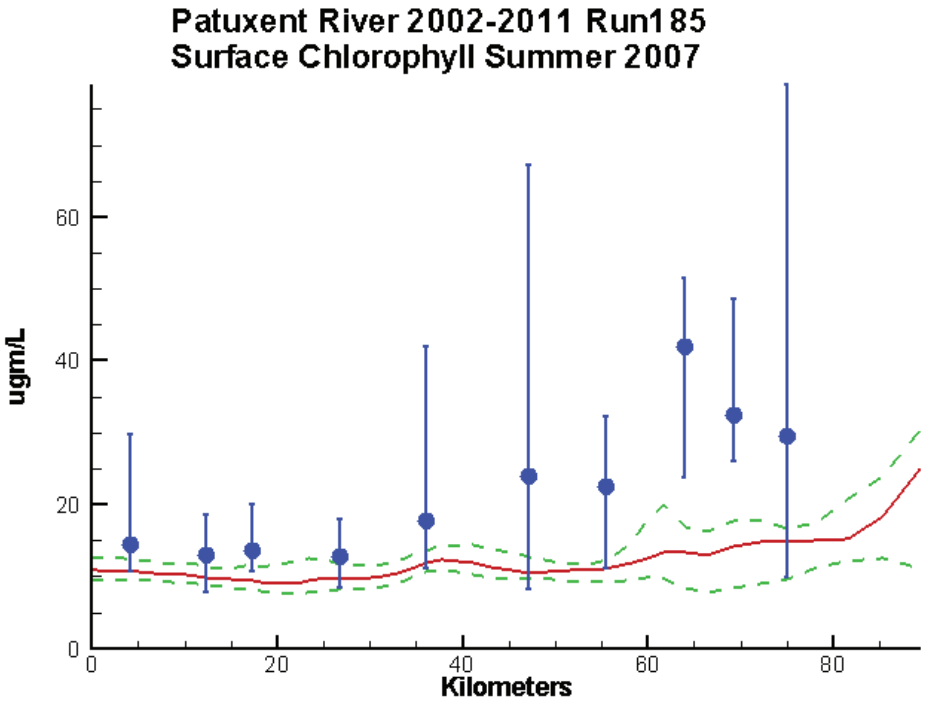


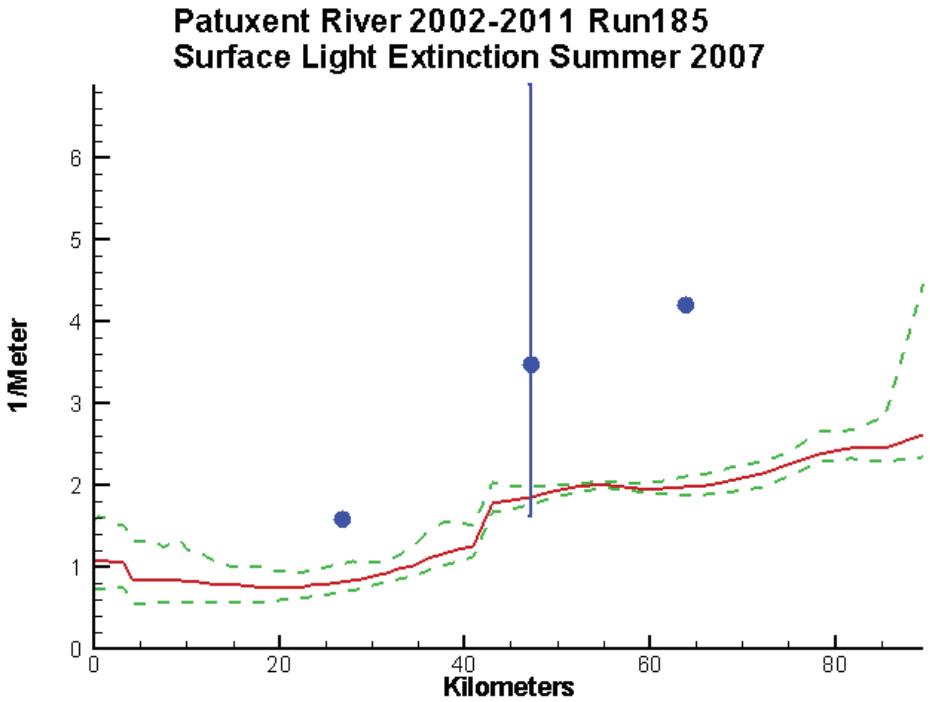


Patuxent River - Summer - 2007

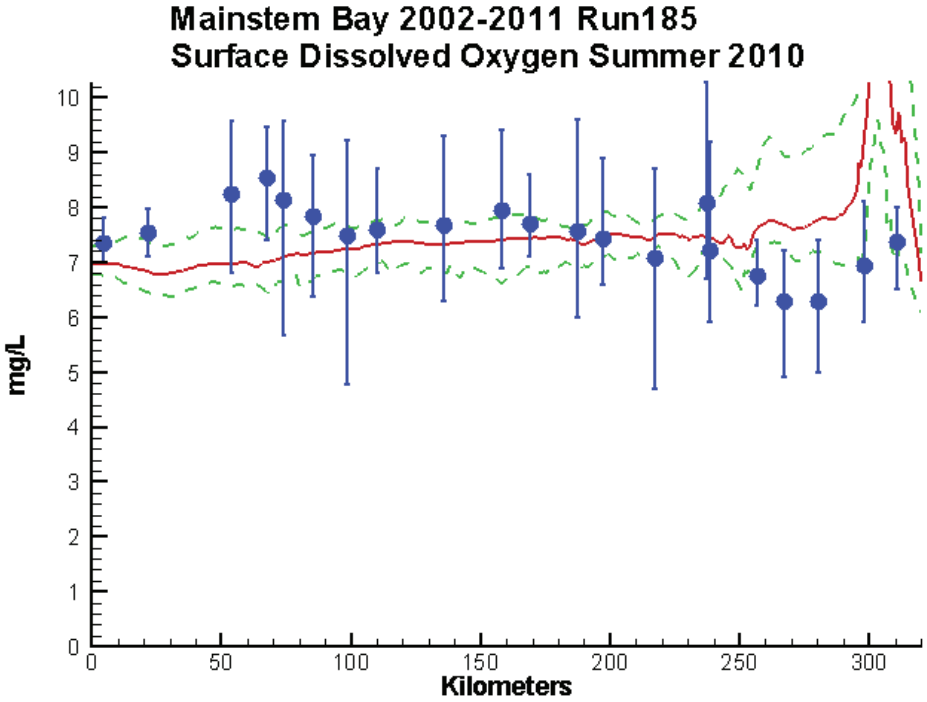


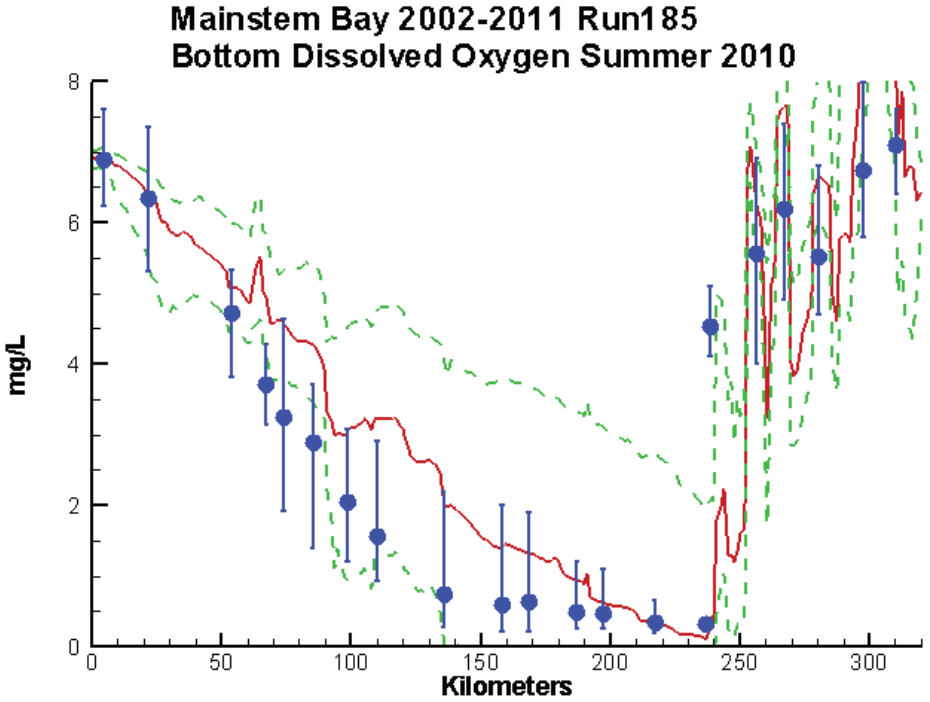


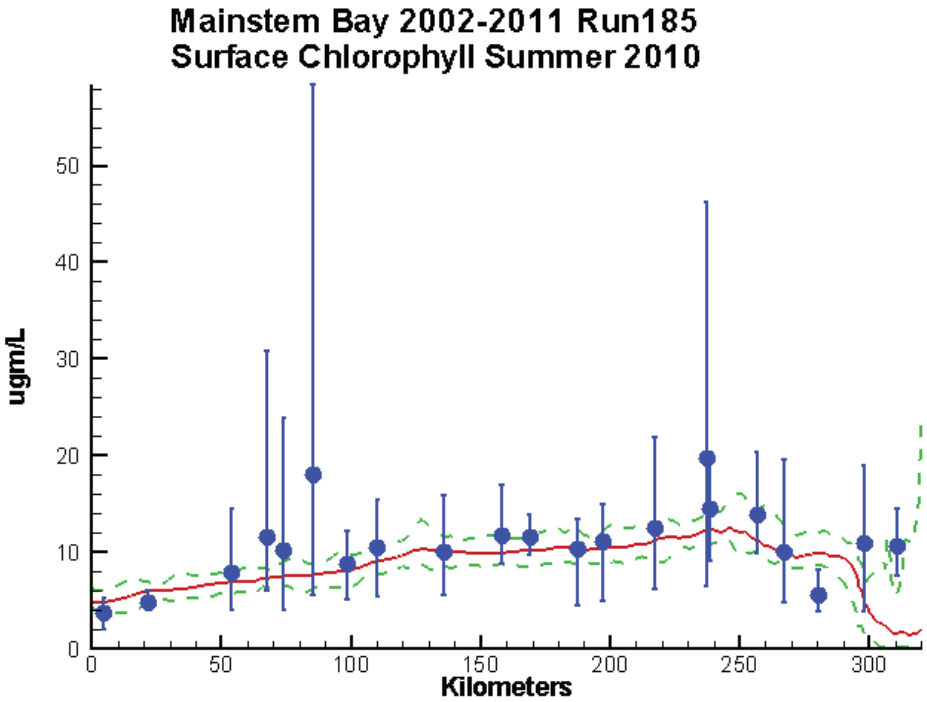


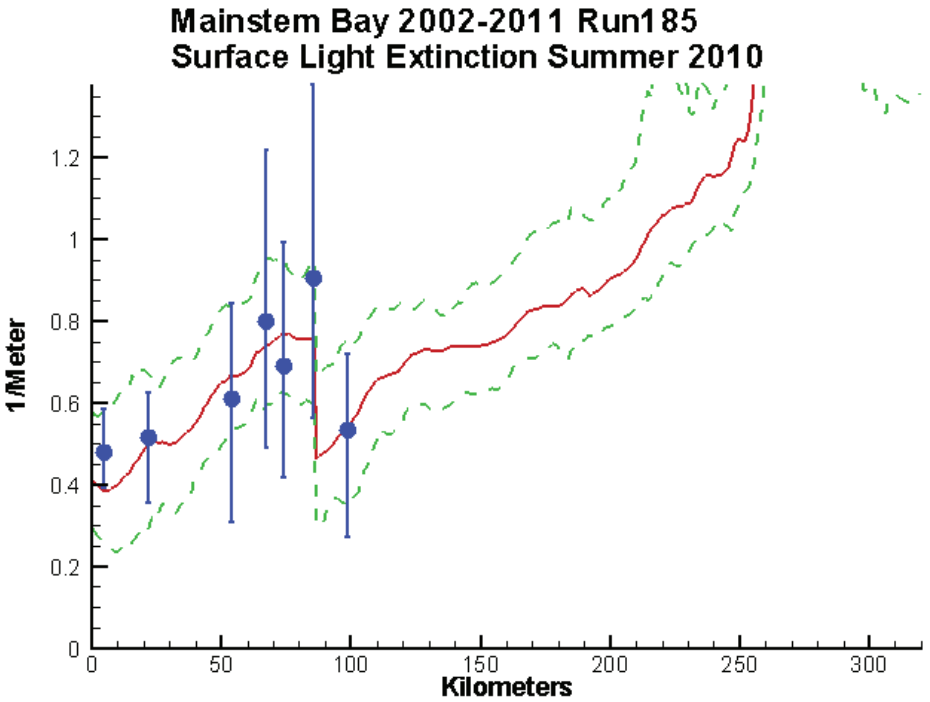


Mainstem Bay - Summer - 2010

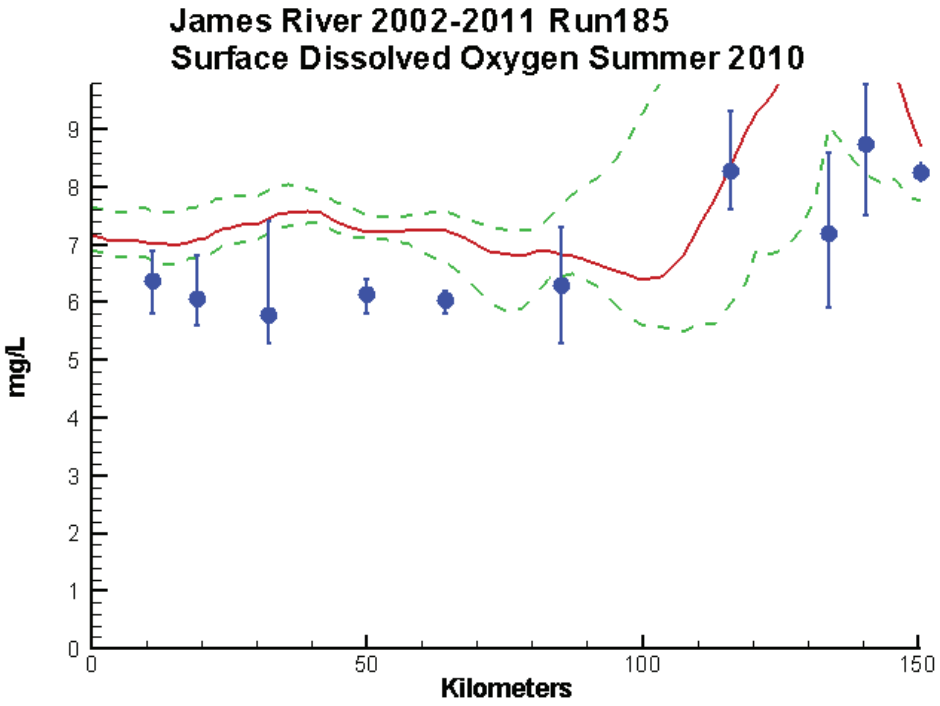


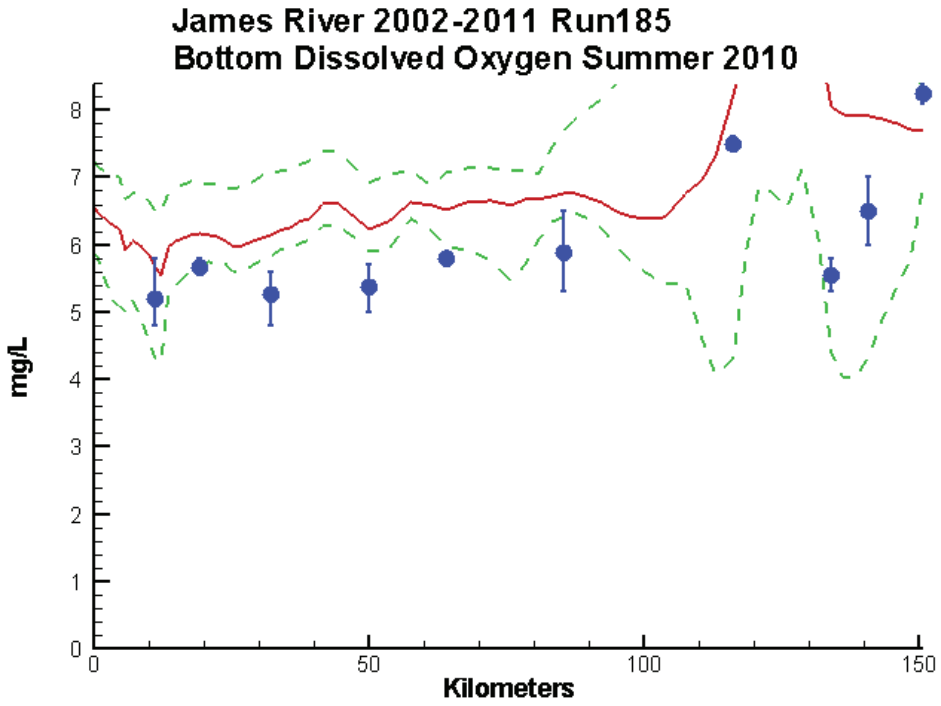


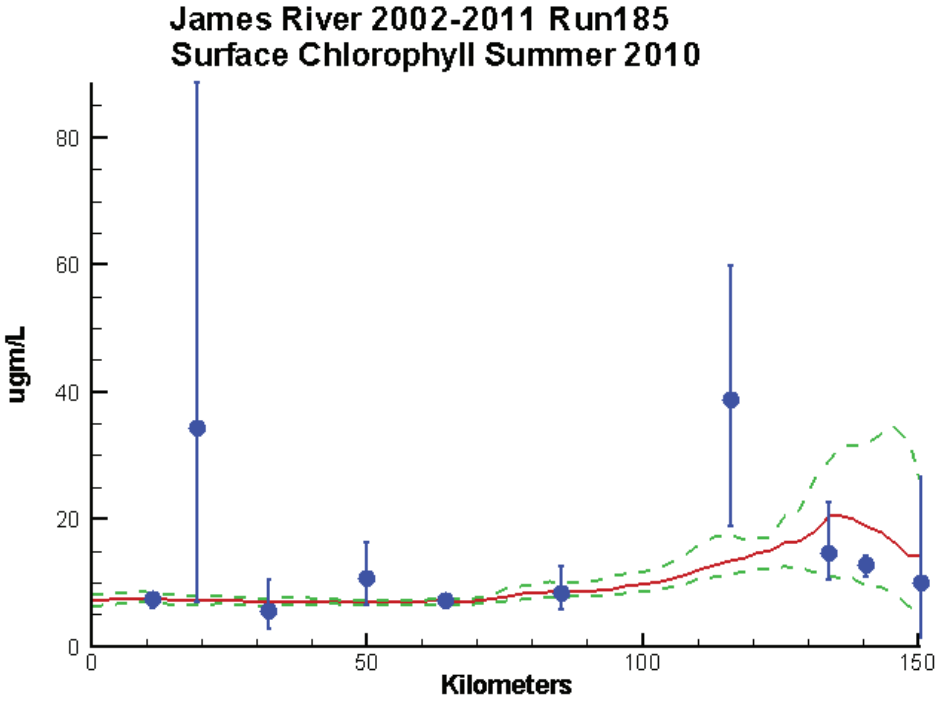


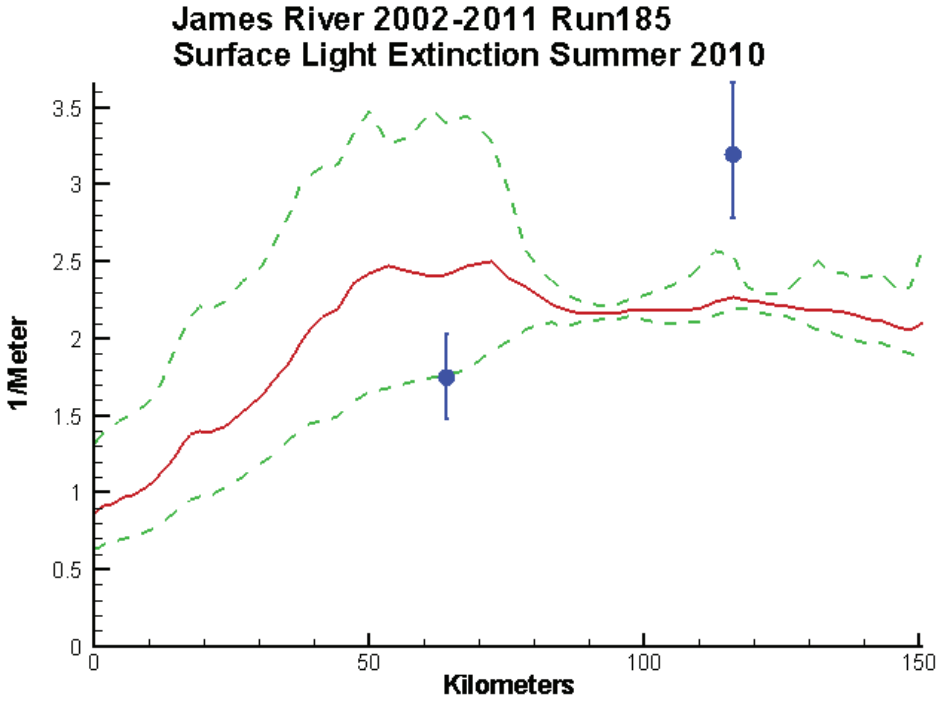


James River - Summer - 2010

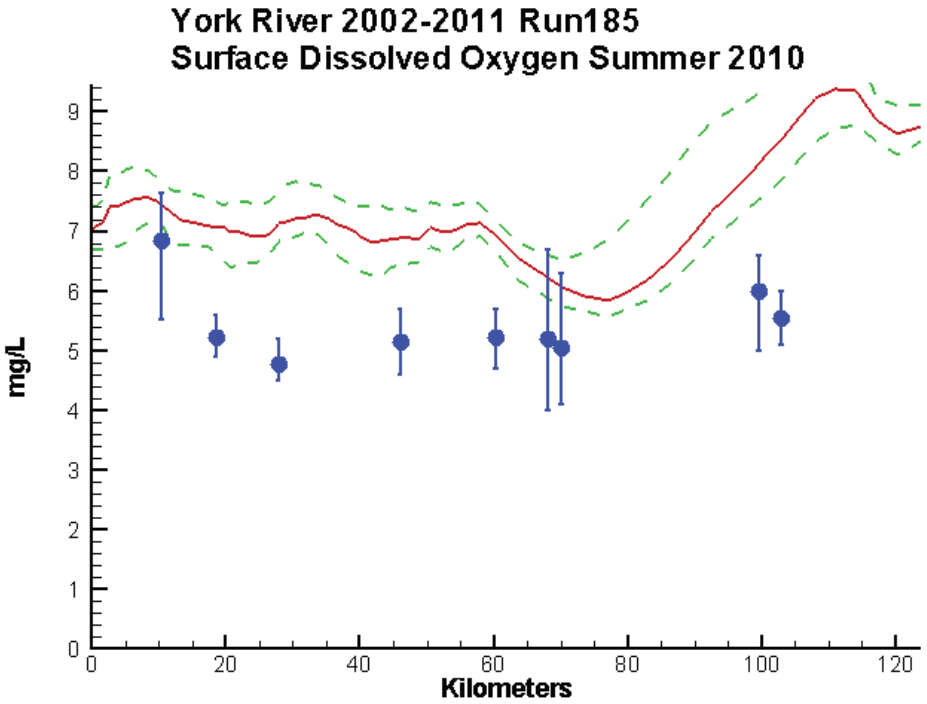


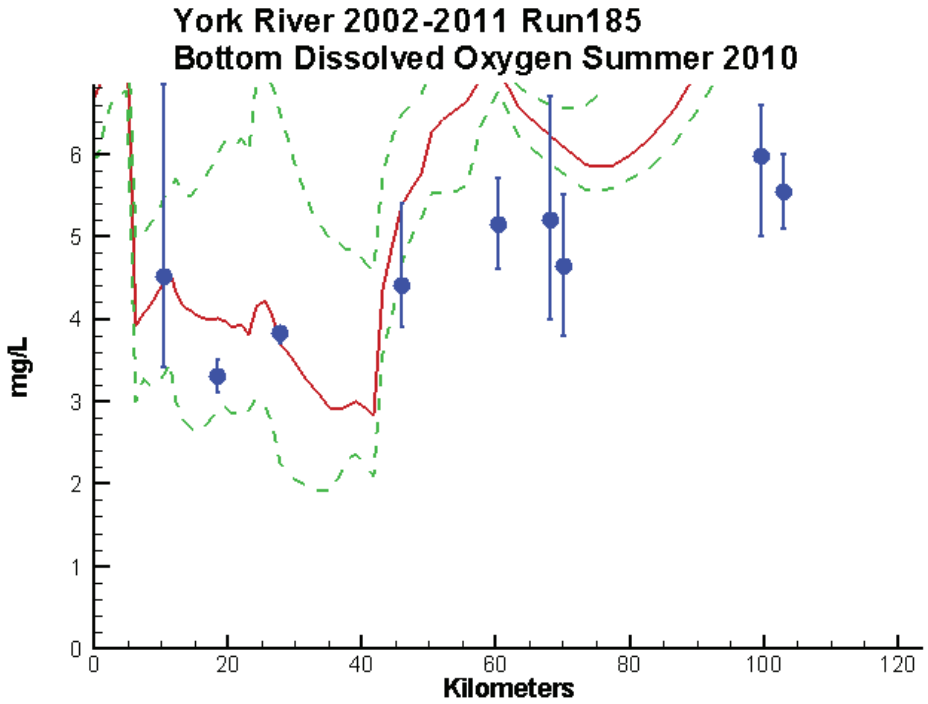


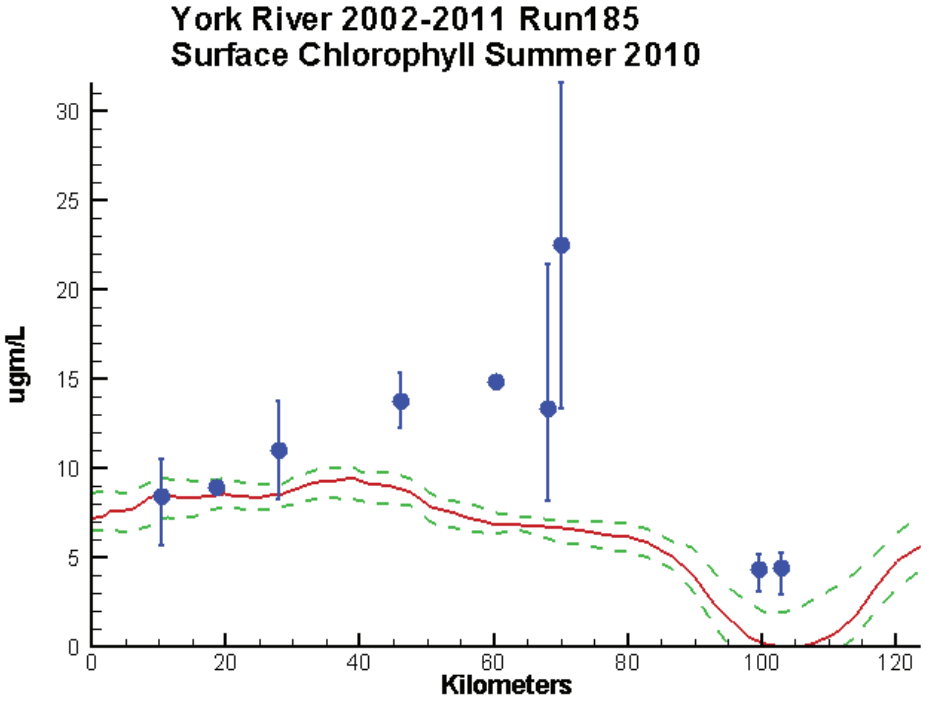


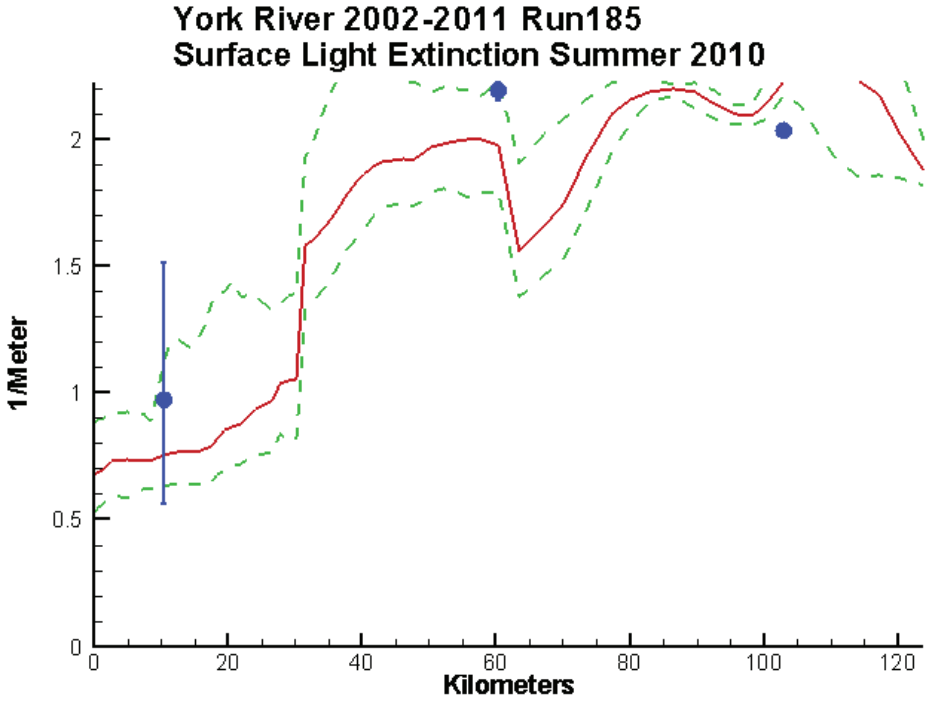


York River - Summer - 2010

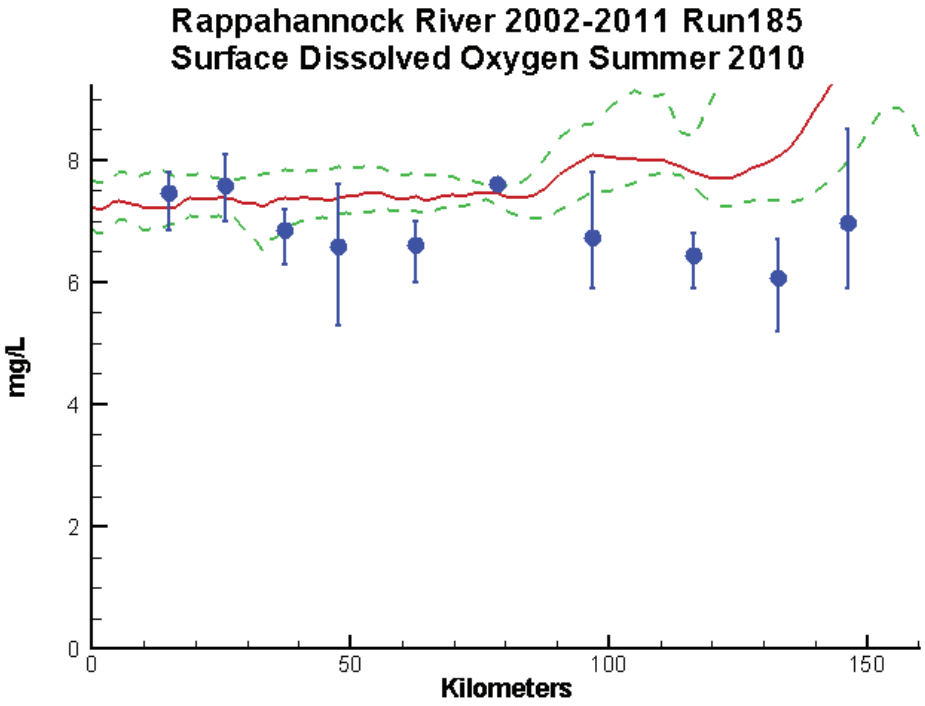


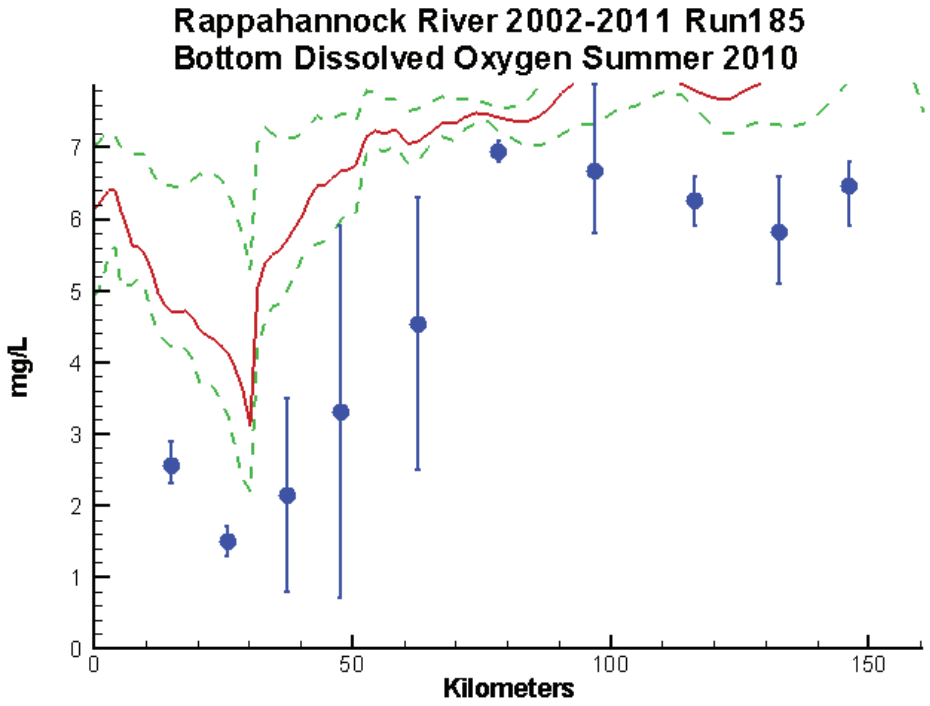


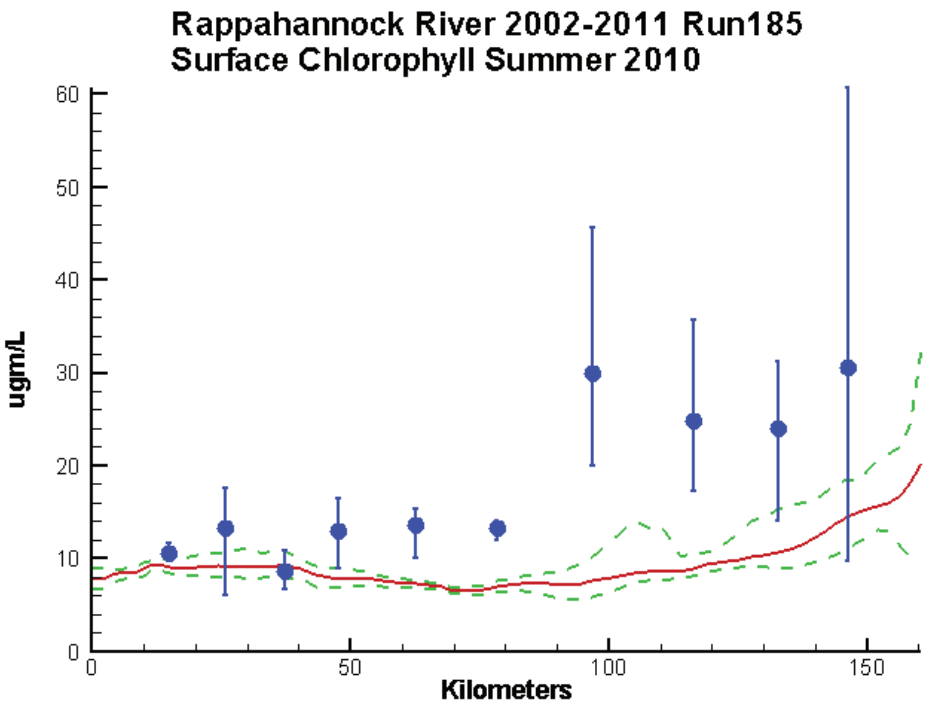


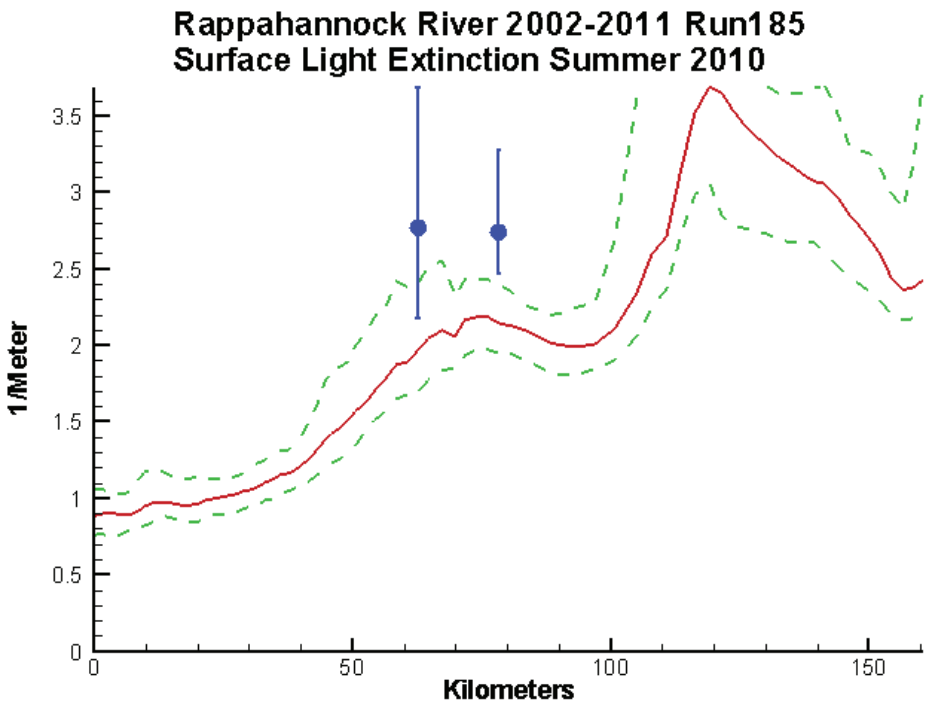


Rappahannock River - Summer - 2010

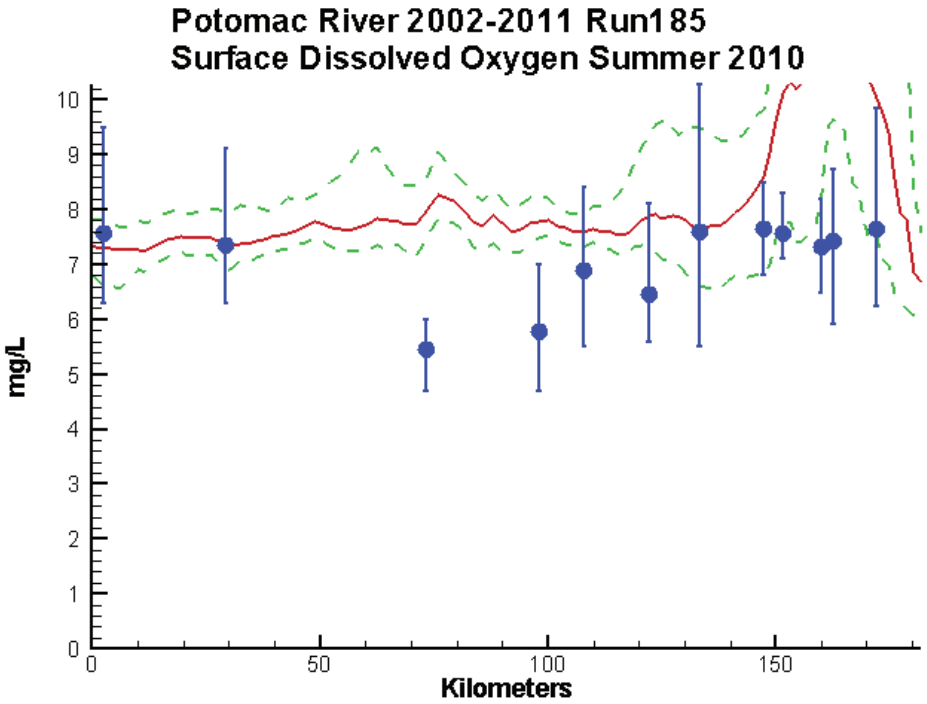


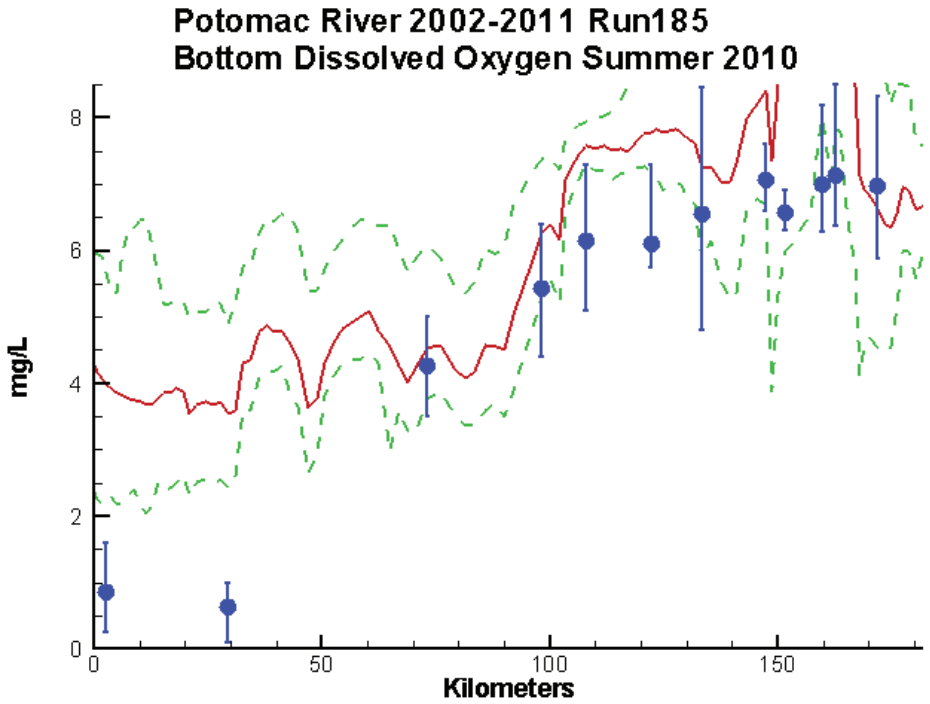


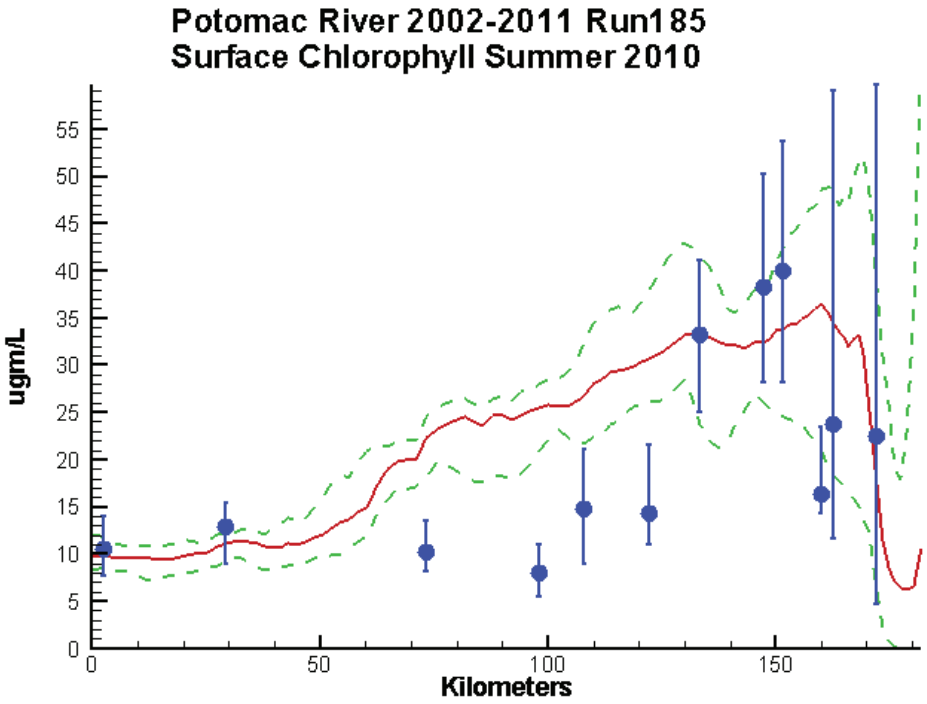


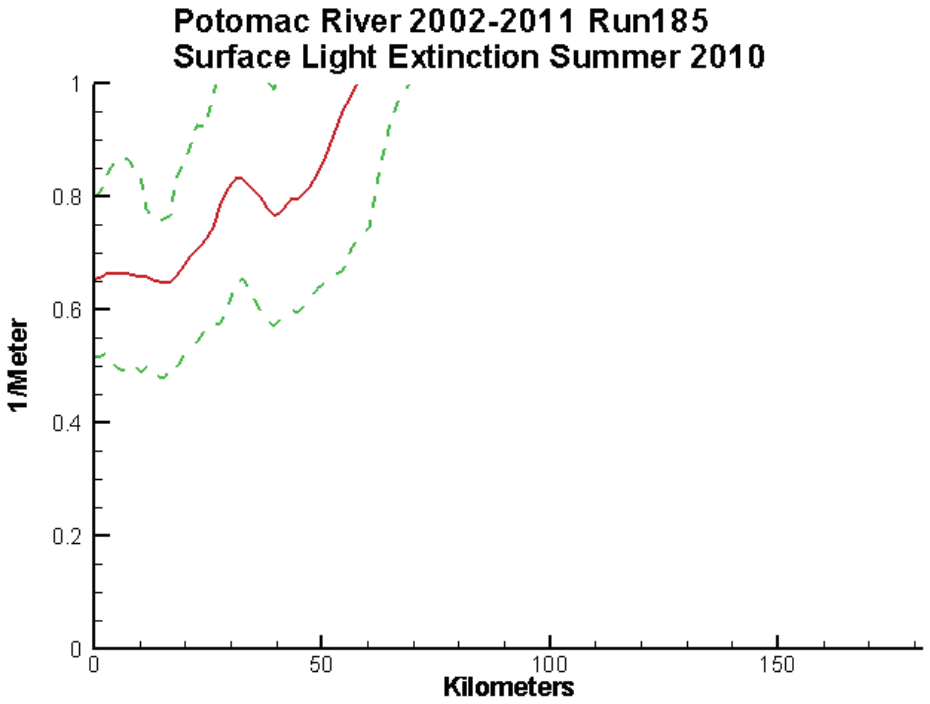


Potomac River - Summer - 2010









Patuxent River - Summer - 2010